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Industries and the bank lending effects of bank credit demand and monetary policy in Germany

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Abstract

This paper presents evidence on the industry effects of bank lending in Germany and identifies the industry effects of bank lending associated with changes in monetary policy and industry-specific bank credit demand. To this end, we estimate individual bank lending functions for 13 manufacturing and non-manufacturing industries and five banking groups using quarterly bank balance sheet and bank lending data for the period 1992:1-2002:4. The evidence from dynamic panel data models shows that industry-specific bank lending growth predominantly responds to changes in industry-specific bank credit demand rather than to changes in monetary policy. In fact, conclusions regarding the bank lending effects of monetary policy are very sensitive to the choice of industry. The empirical results lend strong support to the existence of industry effects of bank lending. Because industries are a prominent source of variation in the bank lending effects of bank credit demand and monetary policy, the paper concludes that the industry composition of bank credit portfolios is an important determinant of bank lending growth and monetary policy effectiveness.

Keywords	:	Monetary policy transmission, credit channel, industry structure, dynamic panel data.
JEL Classification	:	C23, E52, G21, L16.

Non-Technical Summary

There is an ongoing debate about the transmission mechanisms of monetary policy changes in Europe. An important role is hereby assigned to the credit channel of monetary policy transmission that emphasizes the monetary policy response of bank lending. Existing studies on the bank lending effects of monetary policy in Germany assume that industry-specific bank credit growth does not differ between industries. In our view, however, a distinction of bank lending by industry is important since cyclical and structural differences between industries have a potentially strong effect on bank credit growth. The present paper shows that such 'industry effects' primarily reflect bank credit demand effects. Using the industry dimension of microeconomic bank lending data and information on the industry composition of bank credit portfolios, the present paper investigates the sensitivity of bank lending to changes in bank credit demand and monetary policy in Germany.

In order to determine the sensitivity of bank lending to changes in bank credit demand and monetary policy, we specify dynamic panel data models along the lines suggested in Ehrmann et al. (2003) and Worms (2003). The empirical models are defined for 13 industry sectors and 5 banking groups. The banking group and industry dimension of the data permits the identification of bank lending effects, which result from banking group specific differences in the industry composition of bank credit portfolios.

The empirical analysis shows that bank credit growth predominantly responds to changes in industry-specific factors. Strong effects arise from industry-specific output growth and industry-specific inflation. Banking group effects are weak in comparison to industry effects. The effect of monetary policy changes on industry-specific bank lending differs between industries. The sensitivity of bank lending to changes in monetary policy hence depends on the structure of bank credit portfolios.

Nicht-Technische Zusammenfassung

In Europa gibt es eine anhaltende Diskussion zu den Transmissionsmechanismen monetärer Impulse. Eine wichtige Rolle spielt dabei der sogenannte Kreditkanal, der das Kreditangebot in den Mittelpunkt der Überlegungen stellt. Vorliegende Untersuchungen zum Kreditkanal in Deutschland berücksichtigen mögliche Industrieeffekte für die Kreditentwicklung nicht. Aus unserer Sicht ist aber eine Unterscheidung nach Industriesektoren potentiell wichtig, da zyklische und strukturelle Unterschiede zwischen den Sektoren die Kreditentwicklung stark beeinflussen können. In dem vorliegenden Papier werden solche 'Industrieeffekte' als durch die Kreditnachfrage dominiert angesehen. Unter der Verwendung von Daten über die Kreditentwicklung verschiedener Industriesektoren und deren Bedeutung in den Kreditportfolios der Bankengruppen untersucht das Papier, welche Rolle Veränderungen in der Kreditnachfrage und geldpolitische Maßnahmen für die Kreditentwicklung in Deutschland spielen.

Die hier untersuchten Modelle orientieren sich grundsätzlich an den Arbeiten von Ehrmann et al. (2003) und Worms (2003). Wir verwenden dynamische Panelschätzungen. Bei den Schätzungen wird nach 13 Industriezweigen und 5 Bankengruppen differenziert. Die Bankengruppen- und Industriedimension der Daten erlaubt es dabei, Effekte auf die Kreditvergabe zu identifizieren, die sich aus Unterschieden in der Industriezusammensetzung der Kreditportfolios der Bankengruppen ergeben.

Die empirische Analyse zeigt, dass das Kreditwachstum vor allem auf industriespezifische Faktoren reagiert. Starke Effekte gehen vom Industriewachstum und von der Preisentwicklung in den jeweiligen Industrien aus. Bankengruppeneffekte sind dagegen vergleichsweise schwach. Die Auswirkungen monetärer Impulse auf die Kreditvergabe an individuelle Industrien variieren zwischen den Industriezweigen. Die Reaktion der Kreditentwicklung der Bankengruppen auf geldpolitische Maßnahmen ist dementsprechend von den Portfoliostrukturen der Banken abhängig.

Contents

Industries and the Bank Lending Effects of Bank Credit Demand and Monetary Policy in Germany[1]

1 Introduction

Existing research emphasizes the importance of the interest rate and credit channel as propagation and amplification mechanisms of monetary policy changes. Both types of transmission channels predict bank lending to change in response to monetary policy actions. While the direction of the change is the same in the credit and interest rate view, the underlying reasons differ. The credit channel view explains monetary-policy-induced movements in bank lending with changes in bank loan supply, whereas the interest rate channel stresses changes in bank loan demand. Apparently, the correlation of monetary policy shocks with loan demand and loan supply and the consequent role of interest rates as joint determinant of credit demand and credit supply precludes the unique identification of the interest rate and credit channel effects of monetary policy.

In order to identify the loan supply effects of monetary policy, empirical studies typically rely on disaggregated macro- or microeconomic data. These illustrate the distributional effects of monetary policy by stressing the within-group and between-group heterogeneity of banks in terms of asset size (e.g., Kashyap and Stein, 1995), liquidity (e.g., Kashyap and Stein, 2000), and capitalization (e.g., Peek and Rosengren, 1995). When stressing bank characteristics, the identification of bank credit supply effects rests on several assumptions. Firstly, it is assumed that bank heterogeneity in bank size, liquidity, and capitalization reflects cross-bank differences in the severity of asymmetric information problems and consequently differences in the ability of banks to offset monetary-policy-induced changes in deposits with other types of finance. Cross-bank differences in bank characteristics are not allowed to reflect differences in bank customers. Secondly, the response of bank lending to changes in bank credit demand is assumed to be homogenous across all banks.[2] Thirdly, banks are assumed to serve customers

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[2]For details see Deutsche Bundesbank (2001), Worms (2003) and the theoretical and empirical review on

which do not differ in terms of bank credit demand. These are strong assumptions and their potential violation suggests the persistence of the identification problem.

The identification bias is likely to be particularly strong for Germany for two reasons. The first reason refers to the housebank principle in German banking. German banks belong to banking groups which confine their business to customers which differ in the degree of bank dependence: commercial banks are the housebank to large corporations and savings and cooperative banks are the housebanks to small- and medium-sized firms.[3] Small firms tend to be more dependent on banks as source of external finance than large firms. The greater bank dependence results from credit market imperfections, which are more severe for small than for large firms given that reporting and accounting standards become more stringent with firm size. Credit market imperfections therefore cause the portfolio of savings and cooperative banks to be biased towards bank-dependent firms and that of commercial banks to be biased towards firms with access to non-bank sources of finance (cf. Deutsche Bundesbank, 1998a, 2002a). In view of these relationships, banking groups are likely to differ in the extent to which they (i) face changes in credit demand and (ii) adjust credit supply.

The second reason refers to the existence of pronounced cross-industry differences in credit demand. The Deutsche Bundesbank (1996) attributes these to heterogeneities in the cyclical and structural characteristics of industries. The cyclicality of industry output affects the need for external finance through its impact on the availability of internal funds of finance. Cross-industry differences in bank credit demand reflect dissimilarities in the amplitude and frequency of cyclical fluctuations and in the sensitivity of cash flows to cyclical demand changes. Structural characteristics such as the degree of capital intensity, firm size distribution, or openness to trade emphasize industry differences (i) in the costs of maintaining and expanding production structures and (ii) in the severity of credit market imperfections as source of differences in credit demand.

Existing studies on the bank lending effects of monetary policy primarily assume that bank credit demand does not differ between debtors in general and industries in particular. The underlying analyses involve the estimation of bank lending functions for the aggregate economy, where macroeconomic aggregates approximate credit demand.[4] Although the macroeconomic data are useful since they are available for long time periods at relatively high frequencies, the underlying models only illustrate the bank lending effects of credit demand changes for the average industry. Differences in credit demand across industries are ignored. In addition, macroeconomic data do not control for possible differences in the monetary policy response

the bank lending effects of monetary policy in chapter 2. This is comparable to the credit channel assumption that the interest rate sensitivity of credit demand does not depend on firm size.

[3]See Elsas and Krahnen (2004) for evidence on the role of housebanks as source of finance for small and large firms in Germany.

[4]See, for example, Deutsche Bundesbank (2002c), De Bondt (1998), Kakes and Sturm (2002), Ehrmann et al. (2003), Worms (2003), Gambacorta and Mistrulli (2004), Hülsewig, Winker, and Worms (2004).

of industry-specific bank lending. The effectiveness of monetary policy is thus considered to be independent of the industry structure of bank credit portfolios. Furthermore, most studies do not account for possible cross-banking group differences in the response of bank lending to changes in bank credit demand or monetary policy. Instead, they typically provide evidence for an aggregate measure of all banks, disregarding cross-banking group effects.[5]

In our view, however, knowledge regarding the industry effects and banking group effects of bank lending is important as the results illustrate whether the effectiveness of monetary policy depends on the industry composition of bank credit portfolios and on the institutional setting of the banking system. The results may help to anticipate the effect of banking sector consolidation and industry specialization on future monetary policy efficacy. This paper is motivated by these considerations. We do not impose the assumption of homogenous bank credit demand, but use the industry dimension of bank lending data to identify the response of bank credit supply to changes in industry-specific bank credit demand and monetary policy in Germany. We do not only compile evidence for the aggregate banking sector. Instead, we distinguish the savings banking group and the sub-groups of the credit cooperative banking sector in order to identify the bank lending effects which are due to cross-banking group differences in the industry composition of bank credit portfolios. We hypothesize that industries and banking groups determine the response of bank lending to changes in bank credit demand and monetary policy. In particular, we argue that changes in bank lending are industry-specific and that the industry composition of a bank's loan portfolio determines the effectiveness of monetary policy through credit channel effects.

We discuss two questions. Firstly, are changes in the industry-specific volume of bank credit explained by bank lending effects of monetary policy or do they reflect changes in industry-specific bank credit demand?[6] Secondly, does the sensitivity of bank lending to changes in monetary policy or bank credit demand differ between industries or between banking groups? We address these problems for Germany using the Bundesbank database on bank lending and bank balance sheet information. The answer to these questions will show that industry bank lending predominantly responds to changes in industry bank credit demand rather than to monetary policy changes. Furthermore, the results lend very strong support to the existence of industry effects of bank lending, whereas banking group effects are comparatively weak. Evidence in favor of credit channel effects of monetary policy crucially depends on the choice of industry and banking group. In view of these findings, we conclude that empirical studies which do not control for the industry structure of bank credit provide an incomplete view on the bank lending effects of bank credit demand and monetary policy. The underlying results

[5]The notable exceptions are Küppers (2001) and Kakes and Sturm (2002) who distinguish banking groups in empirical studies for Germany.

[6]Throughout this paper, we cannot control for the response of bank lending to monetary-policy-induced changes in credit demand. However, to the extent that monetary policy affects industry output or industry price only with a lag, changes in the volume of bank loans can still predominantly be attributed to changes in bank credit demand. Also see section 7 for additional caveats of the present empirical analysis.

only reflect the impact of the average industry. However, neglecting banking group effects is unlikely to affect the overall conclusions as to the determinants of bank lending.

The paper is structured as follows. Section 2 reviews the existing evidence on the credit channel effects of monetary policy via bank lending in Germany. Section 3 describes the German banking industry. Within this framework, the discussion stresses the balance sheet structure of the main banking groups and the industry structure of the corresponding loan portfolios. Section 4 discusses the empirical model and the empirical estimation strategy. Section 5 presents the industry and bank data and describes the bank outlier detection procedure. Section 6 reports the empirical results from dynamic panel estimations and robustness checks. We will ask whether differences in the response of bank lending to changes in bank credit demand and monetary policy are explained by effects associated with banking groups or industries. We conclude in section 7.

2 The Credit Channel Effects of Monetary Policy in Germany

This section reviews the existing empirical evidence on the bank lending effects of monetary policy. Common to the existing studies is that they typically do not determine the response of bank lending to changes in bank credit demand.[7] When studies control for the bank lending effects of bank credit demand, they do not allow bank credit demand to differ between different types of customers.[8] Given the lack of evidence on the response of bank lending to changes in bank credit demand, this section primarily analyzes the existing evidence with respect to the bank lending effects of monetary policy.

There is a wide range of studies on the bank lending effects of monetary policy in Europe. Because individual firm and bank-level data are only available to a limited extent, the empirical investigations largely rely on aggregate data.[9] Aggregate studies can be criticized for providing an incomplete view on the bank lending effects of monetary policy because they only identify the monetary policy response of bank lending associated with the average bank and average debtor. Empirical studies with disaggregated lending data provide more insights on monetary policy transmission since they distinguish the monetary policy response of the individual components of bank lending. The corresponding evidence in, for example, Dale and Haldane (1995), Barran, Coudert, and Mojon (1997), Kakes, Sturm, and Maier (2001), Küppers (2001), Kakes and Sturm (2002), and De Haan (2003) points to the sensitivity of the results to the type of bank loan and to the choice of banking group.

[7] Dale and Haldane (1995) implicitly allow for differences in bank credit demand between the corporate and household sector. Unfortunately, the analysis does not identify the response of bank lending to changes in bank credit demand.

[8] See, for example Ehrmann et al. (2003) and Worms (2003).

[9] See, for example, Guender and Moersch (1997), Garretsen and Swank (1998), Holtemöller (2003), Hülsewig, Winker, and Worms (2004), and Hülsewig, Mayer, and Wollmershäuser (2005).

While studies using disaggregated data allow for more detail on the determinants of bank lending, they still provide an incomplete view. This is because they identify the bank lending effects of monetary policy by exploiting the between-group but not the within-group dissimilarities of agents and markets. For example, Kakes and Sturm (2002) capture differences in bank size by estimating separate models for different banking groups. The corresponding evidence allows for behavioral asymmetries between different banking groups, but not between banks within each banking group. In contrast to macroeconomic and disaggregated studies, microeconomic studies exploit heterogeneities within samples to identify the bank credit demand and the bank credit supply effects of monetary policy.

Many microeconomic studies for European countries including Germany build on BankScope data (cf. De Bondt, 1998; Favero, Giavazzi, and Flabbi, 1999; Altunbaş, Fazylov, and Molyneux, 2002).[10] Although the corresponding studies employ similar data, they differ in their conclusions regarding the credit channel effects of monetary policy in Germany: credit channel effects through bank lending are particular to De Bondt (1998), but do not prevail in Favero, Giavazzi, and Flabbi (1999) and Altunbaş, Fazylov, and Molyneux (2002). The results hence appear to be sensitive to the choice of estimation method and sample period. Besides this aspect, the evidence from BankScope data is also subject to a large sample bias. In order to avoid this bias, Ehrmann et al. (2003) and Worms (2003) use microeconomic data compiled by the Deutsche Bundesbank. Both studies empirically account for the response of bank lending growth to changes in bank lending demand and monetary policy by estimating dynamic panel models using bank-specific bank asset size, liquidity, and capitalization as loan supply proxy variables and macroeconomic measures of economic activity as loan demand variables. The evidence from both studies points to the transmission of monetary policy shocks through bank lending, although cross-study differences prevail as to the source of bank distributional effects. Ehrmann et al. (2003) stress cross-bank differences in liquidity, while Worms (2003) emphasizes cross-bank heterogeneities in liquidity and capitalization. Worms (2003) shows that bank size per se only captures cross-bank differences in the bank lending effects of monetary policy when the analysis controls for short-term interbank deposits. As regards loan demand factors, Ehrmann et al. (2003) find bank lending to respond to inflation, but not to output growth. Worms (2003), in contrast, documents a positive response of bank lending growth to an increase in real output and hence bank credit demand.

To summarize, existing studies report ambiguous results regarding the bank lending effects of monetary policy in Germany. The ambiguity prevails for micro- as well as for macroeconomic analyses. Furthermore, existing empirical studies differ in the cross-sectional dimension of the estimations. Some studies only exploit a single data dimension and divide the banking sample by either bank size, bank liquidity, or bank capitalization. Other studies also split the sample along a second dimension, using the maturity of bank credit, the banking group,

[10] We only refer to those studies which contain Germany. See Angeloni, Kashyap, and Mojon (2003) for a compilation of microeconomic studies that document the credit channel effects of monetary policy in European countries.

or the group of debtors as additional model criterion. Among the existing studies, only Worms (2003) controls for a possible industry bias in bank lending. However, he models the interdependence between loan supply and industry indirectly by including a weighed average of real sectoral output as measure of bank credit demand. The resulting estimates do not allow for inferences as to the industry-specific effects of bank lending and as to the response of bank lending to industry-specific changes in bank credit demand.

A common caveat applies to the existing empirical studies. When identifying the bank lending effects of monetary policy, the empirical literature does not control for the observation that the identification of the bank credit supply effects is not only complicated by possible heterogeneities in bank credit demand and in the response of bank lending to changes in bank credit demand, but also by the balance sheet effects of monetary policy. The complication arises because balance sheet effects cause the volume of bank lending to be simultaneously determined by bank credit supply and bank credit demand side effects. The supply side effects are at the core of the credit channel theory of monetary policy transmission. This theory argues that the balance sheet (net worth) position of potential borrowers such as firms influences the credit supply decisions of banks. For example, bank credit supply is predicted to decline in response to a monetary contraction given the associated deterioration in the balance sheet position of firms (cf. Bernanke and Gertler, 1989).[11]

In contrast to bank credit supply, a monetary-policy-induced decline in net worth has an ambiguous effect on bank credit demand: it may expand or contract. On the one hand, firms may demand more bank credit in order to be able to finance fixed and inventory investment and to preserve liquidity. On the other hand, firms may not change or even reduce bank credit demand in the wake of a monetary contraction. This response requires firms to be swift in adjusting production to the monetary-policy-induced decline in output demand so as to reduce the variable costs of production and to avoid the costs associated with undesired inventory accumulation. In addition, bank credit demand may decline when firms delay physical capital investment in anticipation of lower future interest rates.

Overall, the balance sheet effect of monetary policy causes bank credit supply to contract, while bank credit demand may expand or contract. Unfortunately, we can only stress this caveat. Similar to existing studies, the present analysis cannot identify the balance sheet effects on bank credit supply or bank credit demand. However, this shortcoming is not expected to affect our conclusions regarding the bank supply effects of monetary policy given that existing empirical research lends no or weak support to the existence of balance sheet effects of monetary policy in Germany. Evidence against the existence of balance sheet effects is provided by Siegfried (2000), Mojon, Smets, and Vermeulen (2002), Chatelain et al. (2003), and Arnold and Vrugt (2004). Von Kalckreuth (2003) reports supportive evidence. However, the balance sheet effect of monetary policy is small.

[11]Also see Trautwein (2000) for a literature review on the balance sheet effects of monetary policy and on the relationship between a firm's balance sheet position and its access to bank credit.

3 Banks and Industries in Germany: An Overview

In order to provide the framework for the subsequent discussion, this section describes the German banking system.[12] To this end, we compile quarterly data from the monthly bank balance sheet statistics and the quarterly borrower statistics of the Deutsche Bundesbank for the period 1992:1-2002:4. Section 5 and appendix A describe the data in detail. We are specifically interested in the balance sheet structure of the main banking groups and in the industry structure of bank credit portfolios.

Throughout this study, we emphasize the industry distribution of aggregate and short-term bank credit. The focus on short-term lending is motivated by existing studies which point to an immediate response of short- rather than long-term lending to changes in monetary policy (Gertler and Gilchrist, 1993; Kakes and Sturm, 2002). Short-term loans are also likely to respond more (i) to cyclical fluctuations in bank credit demand factors like industry output and prices and (ii) to changes in monetary policy since they are renewed at shorter intervals than long-term loans. We also focus on short-term lending because long-term credit is determined by factors that cannot easily be constructed given the available information. Because data on, for example, expected output and prices are unavailable at a low level of industry aggregation, we cannot estimate our empirical model for long-term lending without incurring the risk of reporting biased and inconsistent estimates due to an omitted variable bias. Surely, the omitted variable bias may also affect the results for the model with aggregate lending, where aggregate lending is computed as the sum of short-, medium-, and long-term bank credit. The evidence on aggregate lending should therefore be viewed as reference point to judge the plausibility of the results for short-term lending.

3.1 The Structure of the German Banking Sector

The financing system in Germany is a bank-based system, with banks being the most important source of external finance. The banking system can be divided into two main categories: universal banks and specialized banks. At the end of 2003, the German banking sector consisted of 2,466 banks of which 2,255 were universal and 211 were special. The German banking system is hence a universal banking system. Given this property, the present analysis disregards specialized banks and focuses on the three main universal banking groups, i.e., the savings, cooperative, and commercial banking sector.

Each of the main banking groups can be divided into two tiers. The first tier consists of few large head institutions, which are the Land banks, cooperative central banks, and the big banks for the savings, credit cooperative, and commercial banking sector, respectively. The second tier is composed of many primary institutions: local savings banks in the savings banking sector, credit cooperatives in the cooperative banking sector, and regional and private

[12]See Hackethal (2004) for an extensive discussion of the properties of the German banking sector.

banks in the commercial banking sector. Commercial banks and the head institutions of the savings and credit cooperative sector operate product portfolios which differ from those of the primary savings and credit cooperative banks. The head institutions of the savings and credit cooperative banking sector are the central bank to the corresponding primary (local) banks and offer universal banking services to larger foreign and domestic banks and to non-bank customers (cf. Hackethal, 2004). Particular to the head institutions of the savings banking group is their role in providing services to the government of the state in which they are located. Considering commercial banks, they structure their product portfolio around investment and wholesale banking activities, predominantly serving large rather than small- and medium-sized clients.

Table 1 reports summary statistics for the head and primary institutions regarding the distribution of total assets, bank capitalization, liquidity, short-term interbank claims, and non-bank lending.[13] As is evident for the sample period 1992:1-2002:4, the structural differences between the head and primary institutions are reflected in the descriptive statistics of the bank balance sheet variables. Primary institutions are on average better capitalized than their respective head institutions even though they are smaller. Besides, local savings banks and regional and private commercial banks tend to be more liquid than Land banks and big banks, while the primary institutions of the cooperative banking sector are on average less liquid than their central institutions. Regardless of the banking group, a comparatively large share of liquidity is accounted for by short-term interbank claims. With the exception of regional and private commercial banks, primary institutions hold a larger share of interbank claims than their respective head institutions.

Considering the distribution of lending to non-banks[14], the primary institutions in each banking sector lend on average more to non-banks than the respective head institutions. The difference is particularly pronounced for the credit cooperative sector: lending by central institutes accounts on average for 17 percent of total assets, while the corresponding number for credit cooperatives is 60 percent. The central institutions' low involvement in non-bank lending is attributable to their main role as central bank to the primary credit cooperatives. In this function, they act as clearing institutions for interbank transfers between credit cooperatives and assist primary credit cooperatives in accessing financial markets and in serving their customers.[15]

As regards the share of industry bank credit to non-bank credit, the primary and head insti-

[13] As regards local savings banks, the descriptive statistics refer to public savings banks only. The present study excludes private savings banks since they operate under a different institutional setup. The existence of significant differences in the balance sheet structure of public and private savings banks is confirmed by the test statistics of one-way analysis of variance (ANOVA) for almost all sampled balance sheet items. The ANOVA test statistics are available on request.

[14] Non-bank lending involves bank credit supply to domestic businesses, private households, government, and foreign non-banks.

[15] Also see Hackethal (2004).

tutions of the commercial or savings banking group do not differ in the degree of industry lending. A comparatively large share of aggregate non-bank lending is allocated towards industries (i.e., businesses and self-employed), exceeding 50 percent and 40 percent of total non-bank lending for the commercial and savings banking group, respectively. Pronounced differences again prevail between the primary and head institutions of the credit cooperative sector: industry lending by central credit institutes and primary credit cooperatives accounts on average for approximately two-third and four-ninth of total non-bank lending, respectively. Considering the share of short-term lending to total lending, we find considerable differences between head and primary institutions for all banking groups. Except for the credit co-operative sector, head institutions provide on average less short-term finance than primary banks.

The entries in Table 1 also demonstrate that there are not only differences in the balance sheet structure within each banking group, but also between banking groups. These differences are expected to affect the conclusions regarding the bank lending effects of monetary policy for individual banking groups. For example, banks belonging to banking groups with a relatively large amount of liquid assets (group i) might be better able to insulate their lending activities from monetary policy changes than banks in banking groups with only few liquid assets (group j). If this holds, cross-bank differences in liquidity might be a less important source of bank lending effects of monetary policy in group i than in group j. This in turn suggests that banking group differences in liquidity may affect conclusions regarding the strength of the bank lending effects of monetary policy.

Because they constitute the focal point of the present empirical analysis, we confine the comparison to the primary institutions of the banking groups. As is evident from Table 1, the largest and most liquid banks operate in the savings banking sector, while the smallest and least liquid banks belong to the group of credit cooperatives. The regional and private banks in the commercial banking sector report the largest share of bank capital, exceeding that of savings and cooperative banks by more than 90 and 60 percent, respectively. The descriptive analysis also shows that each banking group reports a high share of non-bank lending to total assets. Whereas the primary institutions of the credit cooperative and savings banking sector report on average comparable shares of non-bank lending to total assets, the corresponding share tends to be lower for the commercial banking group. This reflects the greater involvement of commercial banks in lending to banks.[16]

However, when looking at the share of total industry lending to non-bank lending, the primary institutions of the commercial banking sector lend on average more to industries than savings banks and credit cooperatives. The descriptive evidence suggests that the difference in the average share of total industry lending reflects considerable differences in the role of banking groups as source of short-term finance to industries. Regional and private commercial

[16]For 1992:1-2002:4, the share of bank lending to total assets was on average equal to 34 percent, 13 percent, and 8 percent for commercial, credit cooperative, and savings banks, respectively.

banks tend to be more heavily engaged in short-term finance than credit cooperatives or savings banks. In fact, short-term lending to industries as share of total industry lending is approximately twice as large for commercial banks than for credit cooperatives and savings banks. The apparent weakness of savings banks and credit cooperatives in short-term finance is attributable to their practice of confining business to local areas. Superior knowledge of local market conditions facilitates assessments regarding the long-term creditworthiness of debtors, which yields a comparative advantage in long-term lending.

In order to ascertain the statistical significance of cross-banking group differences in the balance sheet structure, we analyze the variance properties of the bank characteristics by means of a one-way analysis of variance (ANOVA). Table 2 reports the ANOVA test statistics for asset size, liquidity, capitalization, short-term interbank claims, and the volume of bank credit. Panel A contains the results for the three main banking groups, i.e., commercial, savings, and credit cooperative banks and panel B summarizes the evidence for six sub-groups of the credit cooperative banking group. Using the classification scheme of the Deutsche Bundesbank, the credit cooperative sub-groups are commercial cooperatives, rural cooperatives, Raiffeisen banks, Sparda banks, PSD banks (Post-, Spar-und Darlehensvereine), and civil servants banks. We deem this distinction necessary to control for banking group differences in the balance sheet structure and for differences in the type of customer.

A comparison of the mean squared values in Table 2 illustrates that the hypothesis of equal means can be rejected for all bank characteristics and for each banking group sample. The evidence thus points to statistically significant differences in the balance sheet structure of banking groups. This in turn suggests that conclusions regarding the bank lending effects of monetary policy changes might be sensitive to the choice of banking group. To control for this possibility, we will therefore estimate industry-specific bank lending functions by explicitly allowing for individual 'sub-group' effects.

3.2 The Industry Structure of Bank Loan Portfolios

So far, the description of the structure of the German banking sector is confined to the distribution of lending to the grand total of industries. This section extends the analysis in that it stresses the industry structure of bank credit portfolios. Table 3 reports lending to industry i in total lending by banking group for eight industries at the one-digit industry level (main industries) and for nine industries at the two-digit industry level (manufacturing sub-sectors).[17] Given the focus of the present analysis, we only stress the distribution of aggregate and short-term lending as provided by commercial banks (big banks, regional, and private banks) and by the primary institutions of the savings and credit cooperative banking group.

[17]Given a change in the industry classification scheme, the bank lending data display a break in 1995:1. Because the descriptive statistics are robust to the 1995:1 observation, the entries in Table 3 refer to the whole sample period 1992:1-2002:4.

We express aggregate and short-term lending to industry i as share of, respectively, aggregate and short-term lending to the grand total of industries. Because the industry distribution of aggregate and short-term credit is largely comparable, we provide a general discussion.

The statistics in Table 3 point to cross-industry differences in the distribution of bank credit. Banks predominantly lend to industries which account for the largest share of output in the aggregate economy: the service, wholesale and retail trade, and manufacturing industry. Cooperative, savings, and commercial banks hold on average, respectively, 69 percent, 81 percent, and 89 percent of their bank loan portfolio with these sectors.[18]

As regards the remaining main industries, the volume of bank credit tends to be more evenly distributed across sectors. Agriculture and construction primarily obtain bank finance from the credit cooperative banking group, with rural credit cooperatives and Raiffeisen banks being the primary source of bank finance.[19] The importance of credit cooperatives for agriculture and construction reflects the regional character of (i) credit cooperatives and (ii) agricultural and constructing firms: lenders and borrowers confine their activities to a particular local area. In adopting a regional focus, credit cooperatives have superior knowledge of local market conditions, which facilitates assessments regarding local economic prospects and the creditworthiness of potential debtors.

The share of bank credit is on average smallest for the finance and insurance industry. One possible explanation for this relationship are large operating surpluses in the finance sector which reduce the need for external finance in general and bank finance in particular.[20] Next to the finance industry, the energy sector also receives comparatively little credit from commercial banks and from the primary institutions of the savings and credit cooperative banking group. Although not reported in Table 3, the Land banks are an important source of finance to the energy sector. For the period 1992:1-2002:4, 12 percent of total lending by Land banks was directed towards the energy sector, with short- and long-term bank credit accounting for 28 and 60 percent, respectively. The importance of Land banks as source of long-term finance

[18] The data suggest that approximately half of these shares is accounted for by lending to the service sector. While lending to the service sector is certainly substantial, no clear conclusions prevail as to the sector's absolute importance as recipient of bank lending. The reason is that the Bundesbank borrower statistics report bank lending to the service sector as residual of bank lending to the remaining industries. For the remainder of this paper, this shortcoming should be kept in mind when interpreting the empirical evidence for the service sector.

[19] Raiffeisen banks and rural credit cooperatives grant 26 (19) percent and 16 (12) percent of aggregate (short-term) credit to agriculture, respectively. In comparison, the corresponding number for commercial credit cooperatives is 6 (5) percent. The cross-banking group differences are less pronounced for lending to the construction industry. Raiffeisen banks, rural credit cooperatives, and commercial credit cooperatives hold 14 (19) percent, 12 (16) percent, and 12 (15) percent of aggregate (short-term) loans with construction, respectively.

[20] For the time period 1992:1-2002:4, the share of operating surplus to value added equals 51 percent with a standard deviation of 2.30 percent for the finance and insurance sector (own computation using the OECD's STAN database for Industrial Analysis). In comparison, operating surplus accounts for at most 31 percent of value added for the remaining industries.

to the energy sector is attributable to the components of this sector: mining and quarrying; electricity, gas, and water supply. Given the importance of each of these sub-sectors for the functioning of the economy, general interest is with the maintenance and improvement of the underlying infrastructures. Maintenance requires large fixed expenditures, while infrastructure investment involves costs which tend to be sunk. In order to encourage investment, Land banks grant favorable access to especially long-term finance even though investment per se might not be profitable.

Turning to the sub-sectors of the manufacturing industry, lending to each of the sectors only accounts for a small share of total bank credit, with the share of bank credit to each sector being positively related to its size in the aggregate economy. Lending to the manufacturing sub-sectors hence tends to be unevenly distributed. The share of bank credit is comparatively small for the coke and chemicals, rubber and plastic, and non-metallic mineral goods producing sector. However, it is relatively large for the wood and paper, machinery and transport equipment, food, and metals producing sector. In fact, lending to these sectors is of approximately the same magnitude as lending to the finance and transport sector.[21]

4 Empirical Model

The remainder of this paper stresses industry-specific cyclical determinants of bank credit demand as factors which have a strong effect on bank lending to industries.[22] Besides cyclical credit demand factors, we will also stress the role of monetary policy as determinant of industry-specific bank lending and test for credit channel effects of monetary policy via bank lending. The corresponding evidence allows for inferences as to the importance of the industry structure of bank credit portfolios as determinant of monetary policy effectiveness and industry performance through the availability of industry-specific bank credit. Furthermore, we test whether conclusions are robust to the choice of aggregate and short-term bank credit. The remainder of this section presents the industry-specific bank lending functions and the methodological approach that will be employed to identify the industry effects of bank credit demand and monetary policy.

4.1 Empirical Estimation Framework

In order to identify the response of bank lending to changes in bank credit demand and monetary policy, we apply the dynamic panel estimation framework of Ehrmann et al. (2003),

[21]Similar conclusions prevail for descriptive statistics that control for the 1995:1 structural break in the industry bank lending series by dropping the corresponding observation from the analysis. The break results from a redefinition of the industry classification scheme.

[22]In the ideal case, one would also like to explain cross-industry differences in the distribution of credit with structural industry characteristics. Unfortunately, the small number of industries and the unavailability of structural industry data of sufficient quality prevent an analysis along this line.

Worms (2003), and Gambacorta and Mistrulli (2004) to estimate a set of bank lending functions. Although we use the same structural estimation framework, the analysis adds to the existing work by exploring the industry dimension of bank lending. Equation (1) describes the empirical bank lending function for bank b and industry i.[23]

$$\Delta L_{bi,t} = \alpha_b + \sum_{j=1}^{p} \beta_{ij} \Delta L_{bi,t-j} + \sum_{j=1}^{p} \gamma_{1j} \Delta r_{M,t-j} + \sum_{j=1}^{p} \gamma_{2,ij} \Delta IP_{i,t-j} + \sum_{j=1}^{p} \gamma_{3,ij} \Delta Price_{i,t-j} + \gamma_4 X_{b,t-1} + \sum_{j=1}^{p} \gamma_{5j} X_{b,t-1} \Delta r_{M,t-j} + \epsilon_{bi,t}. \quad (1)$$

The coefficient α_b is a bank-specific intercept that is included to allow for fixed effects across banks and $\epsilon_{bi,t}$ is an i.i.d. random variable with zero mean and constant variance, i.e., $N \sim (0, \sigma_2)$. $L_{bi,t}$ denotes aggregate or short-term lending by bank b to industry i at time t, with $b = 1, \ldots, N_b$ and $t = 1, \ldots, T$. The autoregressive parameters β_{ij} are assumed to be the same across banks, but heterogeneous across industries. Furthermore, they may differ across banking groups. In order to control for cross-banking group differences, we estimate the model for individual banking groups.

Δ is the first log-difference operator of variable V defined as $\Delta \equiv \log V_t - \log V_{t-1}$. With the exception of the money market interest rate, the first log-difference transformation is applied to all variables. The money market interest rate enters in first differences. Ehrmann et al. (2003) motivate the first-difference structure of the empirical model by stressing that the monetary policy effect on bank lending is confined to new loans. They hence interpret the first log-difference of bank credit as flow variable and introduce the level of loans as stock variable. When suggesting this measure of new loans, Ehrmann et al. (2003) fail to recognize that the first difference is an imperfect measure of new bank loans since it reflects the net effect of new loan issues and loan repayments. Unfortunately, the present study can only acknowledge this shortcoming, but cannot resolve it because of data unavailability. As a consequence, reductions in the volume of loans outstanding may reflect a decline in new loan issues or a net increase in loan repayments.

IP_{it} approximates industry-specific output at time t which serves as a measure of cyclically determined industry-specific bank credit demand. $Price_{it}$ denotes the industry-specific price at time t and is included to capture cyclical fluctuations in industry-specific price developments and their effect on bank credit demand. Unfortunately, industry output and industry price do not only determine the external financing needs of industries, but also influence the

[23] Also see section 6.4 and appendix C for alternative model specifications. An appealing alternative specification of model (1) stacks bank lending by industry for all industries and captures industry effects with industry dummies. Given the large number of banks and industries, computational limitations preclude the realization of this approach in the present framework.

perceptions of banks as to the riskiness of industries. The importance of industry output and industry prices as measures of risk implies, however, that a unique identification of bank credit demand effects with output and prices is infeasible. These variables may also affect bank credit supply through balance sheet effects.[24] For example, a decline in industry output and a decline in industry prices reduces the willingness of banks to grant loans since both developments worsen the balance sheet position of firms, which leaves them more risky.

Industry output may also determine the access to bank finance because it influences the ability of sectors to offer collateral in return for external finance. Given that banks perceive industries with little collateral to be more risky, lending to these industries is likely to be comparatively low. This relationship suggests that output may affect bank lending beyond the effect suggested by cross-industry differences in bank credit demand. Unfortunately, we can only acknowledge the caveat that industry output and industry prices are imperfect measures of bank credit demand effects but cannot distinguish the bank credit demand and bank credit supply effects inherent to output and inflation. The empirical evidence for these variables therefore needs to be interpreted with some caution.

Monetary policy actions are represented by the change in the three-months money market interest rate Δr_M. We assume that the interest rate is strictly exogenous to bank lending.[25] In order to identify the bank lending effects of monetary policy, the money market interest rate $(r_{M,t-j})$ at time t-j is interacted with bank characteristics $(X_{b,t-1})$ at time t-1. The vector of bank-specific characteristics X_b includes asset size (TA), liquidity (A), and capitalization (K) at time t-1. Bank characteristics are introduced with one lag to avoid an endogeneity bias (cf. Kashyap and Stein, 1995, 2000; Ehrmann et al., 2003; Worms, 2003; Gambacorta and Mistrulli, 2004). Appendix B contains a formal definition of the bank characteristics.

Worms (2003) and Ehrmann and Worms (2004) show that the tight relationship between the primary and head institutions of the savings and credit cooperative banking sector causes bank asset size to be an inappropriate proxy variable of the bank lending effects of monetary policy. One explanation is that interbank operations enable small banks to shield their loan portfolio and funding possibilities against monetary policy shocks by providing a relatively unconstrained access to central bank money. In that sense, the interbank market helps to redistribute liquidity within the banking sector from banks with excess liquidity to banks in need of liquidity. This in turn moderates financing constraints for small banks. As a consequence, the interest rate sensitivity of small bank lending does not have to be higher than that of large banks. Bank size might also be an inappropriate measure of information asymmetries because savings banks as well as credit cooperatives back their funds with mutual guarantees. This serves to recapitalize banks and creates a type of insurance scheme for creditors in case of bank insolvency. The existence of these insurance schemes implies that

[24] We thank Heinz Herrmann for rising this point. Also see section 2 for a corresponding note.

[25] See Worms (2003) for empirical evidence as to the robustness of the interest rate response of bank lending to the assumption of exogeneity.

information asymmetries may not affect the lending behavior of banks. Consequently, size appears to be an inadequate variable to identify the loan supply effects of monetary policy and alternative better measures might be bank capitalization or bank liquidity.

The present model employs a 'broad' and 'narrow' measure of bank liquidity. The main difference concerns the way short-term interbank claims are treated. The 'broad' measure of liquidity includes short-term interbank claims and is defined as the ratio of cash plus securities plus short-term interbank claims over total bank assets. For this definition, possible significant relationships between bank liquidity and the monetary policy response of bank lending can be driven by short-term interbank claims (cf. Worms, 2003 and Ehrmann and Worms, 2004). In order to determine whether short-term interbank claims indeed drive liquidity effects, we follow Worms (2003) and split the broad measure of liquidity into two components: (i) a 'narrow' part of liquidity defined as the ratio of cash plus securities over total bank assets and (ii) the share of short-term interbank claims to total assets. Both components are separately included in estimations of model (1).[26] The corresponding models will subsequently be referred to as narrow liquidity and interbank specifications.

We summarize the bank lending effects of changes in monetary policy and changes in bank credit demand by computing the long-run elasticities of bank lending with respect to the explanatory variables in model (1).[27] The industry-specific long-run coefficients $\alpha_{\mathrm{LR,i}}$ are defined as the sum of the lags of the variable in question divided by one minus the sum of the coefficients on the lagged bank credit variable: $\alpha_{\mathrm{LR,i}} = \frac{\sum_{j=1}^{J} \gamma_{ij}}{1-\sum_{j=1}^{J} \beta_{ij}}$, where J=4.[28] Since the long-run coefficients are a non-linear function of the estimated parameters, we derive the corresponding standard errors by means of the standard delta method.[29]

We hypothesize the long-run coefficient estimates in model (1) to enter with the following signs. Motivated by the negative effects of higher interest rates on bank reserves, we expect bank lending to decline in response to a monetary contraction. The distributional effects of monetary policy are anticipated to be such that the response of bank lending to monetary policy changes is less pronounced for larger, more liquid, and better capitalized banks. This holds if the coefficient on the interaction term between each bank characteristic and the interest rate is positive. Ambivalent conclusions prevail with respect to the expected effect of industry output growth on bank lending growth. On the one hand, good economic conditions increase the number of investment projects with positive net present value and hence the

[26] The subsequent analysis will thus report the results for a broad and narrow definition of liquidity and for short-term interbank claims.

[27] We follow the existing literature when referring to long-run elasticities (e.g., Deutsche Bundesbank, 2002b; Gambacorta and Mistrulli, 2004; Worms, 2003; Ehrmann et al., 2003). An alternative and more intuitive interpretation views the 'long-run' coefficient as the lasting response of bank lending growth to changes in either bank credit demand or monetary policy.

[28] The properties of the residuals do not change with J=5.

[29] To conserve on space, we only report the short-run coefficient for the one-period lag of the normalized bank characteristics. The short-run coefficients for the remaining variables are available on request.

demand for bank finance. On the other hand, economic growth stimulates internal cash flows, which may reduce credit demand. Because evidence in favor of a negative relationship between output and bank lending is hardly existing, the long-run coefficient on output growth is expected to be positive.[30]

Finally, industry inflation is anticipated to stimulate bank lending growth.[31] This relationship holds for demand- as well as supply-side-driven developments in prices. On the supply side, industry inflation due to higher input prices may cause firms to demand more bank credit to offset the effect of higher production costs on short-run profits. In order to observe this effect, output prices need to exhibit short-run price stickiness; a phenomenon accounted for by, for example, menu costs. On the demand side, industry inflation may reflect good economic conditions and promising investment opportunities for firms. Similar to the argument for industry output, good investment opportunities may increase the demand for external finance.

The present analysis does not explicitly account for merger-driven changes in the German banking system and hence does not control for the effects of mergers on the individual characteristics of the merging banks. The appropriateness of this approach is suggested by Worms (2003) who finds the long-run bank lending effects of monetary policy to be the same for samples which do not control for mergers and for samples which treat a merged bank as single bank for the pre- and post-merger sample period. Besides, implementation lags between the time a merger is officially announced and the time a merger is legally realized makes it difficult to determine the date of a merger. For these reasons, we will eliminate most merger effects with the outlier detection procedure introduced in section 5.

4.2 Methodology

The system in equation (1) represents a fixed effects dynamic (unbalanced) panel with large T and large N. Lagged values of the dependent variable are included to control for an omitted variable and endogeneity bias. Because the lagged dependent variable is correlated with the error term, dynamic panel models are typically not estimated with the static panel fixed effects estimator. Doing so would introduce a finite sample bias of order $\frac{1}{T}$ for $N \rightarrow \infty$ and fixed T (see Nickell, 1981; Kiviet, 1995). In order to avoid biased and inconsistent estimates, Arellano and Bond (1991) suggest the use of a generalized method of moments (GMM) estimator. Recent studies have challenged this method. Blundell and Bond (1998) and Blundell, Bond, and Windmeijer (2000) have shown that the first-differenced GMM estimates are biased downwards in the direction of the within-group estimates and Alvarez

[30]See De Bondt (1998), Worms (2003), Ehrmann et al. (2003), and Gambacorta and Mistrulli (2004) for evidence in favor of a positive relationship between bank lending and output. Altunbaş, Fazylov, and Molyneux (2002) report a positive output coefficient for medium-sized and undercapitalized banks and a negative coefficient for small-sized and under- or overcapitalized banks in Germany.

[31]Ehrmann et al. (2003) and Gambacorta and Mistrulli (2004) report evidence of a positive price effect on bank lending.

and Arellano (2003) show that the GMM estimator is close to the fixed effects estimator for large T. Furthermore, Jung (2005) illustrates that Arrelano and Bond's (1991) test of serial residual correlation may build on inconsistently estimated residuals. Because these are used to decide on the optimal over-identifying restrictions, coefficient estimates are likely to be inconsistent.

In view of these points and given a comparatively large set of data points in the time dimension, we estimate the dynamic panel model by using the fixed effects estimator. Besides, the use of the fixed effects estimator is also motivated by the evidence from the Hansen J-statistic according to which the over-identifying restrictions in the present set of GMM estimations are invalid regardless of the instrumentalization. In order to ensure that the presence of autocorrelation in the residuals ϵ_{it} does not result in inconsistent and inefficient estimators, we compute White-period standard errors (Arellano, 1987), which are robust to arbitrary serial correlation and time-varying variances in the residuals. We test for the existence of first-order and second-order serial autocorrelation by regressing the within regression residuals against their one- and two-period lag. The underlying model allows for fixed effects and White-period standard errors.[32]

5 Data

Ideally, the analysis of the industry-specific bank lending effects of changes in bank credit demand and monetary policy would build on firm-level as well as bank-level data. Bank-level data allow for the identification of the credit channel effects of monetary policy through bank lending and firm-level data allow for assessments regarding the operation of a credit channel through balance sheet effects. Even though firm-level data are available from the corporate balance sheet statistics of the Deutsche Bundesbank, they are not useful for our purpose because they are only available at an annual frequency and subject to a large firm bias.[33] Given the unavailability of adequate firm-level data, we determine the bank lending effects of changes in credit demand and monetary policy for industry aggregates. Industry data are compiled for industries at the one- and two-digit industry level. The latter are sub-sectors of the manufacturing industry (see Appendix A).

Bank-level data on bank-specific credit supply to individual industries and bank-specific balance sheet variables are respectively obtained from the quarterly borrower statistics and monthly bank balance sheet statistics of the Deutsche Bundesbank for the period 1992-2003. Because data in 2003 display patterns that are irreconcilable with those in earlier years, we confine the analysis of quarterly data to the period 1992:1-2002:4. In addition, the industry

[32]Note, the conclusions regarding the existence of serial autocorrelation are robust to the way in which the first- and second-order autocorrelation coefficient is computed. A simple least-squares estimator without fixed effects and White-period standard errors produces comparable results.

[33]See Deutsche Bundesbank (1998b) for details.

bank lending series are subject to a structural break in 1995:1. Resulting from a redefinition of the industry classification scheme, the break is particularly pronounced for some sub-sectors of the manufacturing industry. In order to avoid that the empirical results capture the effect of the structural break, the 1995:1 observation is, first of all, dropped from all industry estimations. Unfortunately, the residuals of the corresponding estimations are frequently serially correlated and the long-run coefficients therefore biased and inconsistent. In a second step, the bank lending specifications are re-estimated with the 1995:1 observation. Because the consequent error terms tend to behave better and given that the long-run coefficients from estimations with and without the 1995:1 observation compare well in terms of sign, the present paper reports the evidence from specifications with the 1995:1 value. However, we confine the analysis to those industries for which the structural break is less pronounced. This implies that four out of nine sub-sectors of the manufacturing industry are not further considered.[34]

The bank-specific balance sheet and lending data display seasonal patterns. For each bank, these are removed by means of the centered-moving average method. This is an admittedly simple adjustment procedure which can be criticized for ignoring, for example, working day and leap year effects. However, it is the preferred method in the present analysis because it is applicable despite the large number of cross sections. Furthermore, a comparison of the seasonally adjusted and non-adjusted series shows that the centered moving average procedure captures seasonal fluctuations well.

Information on industry production and industry prices is available from the New Cronos database at a monthly frequency for most industries. For some industries, industry output is approximated with industry value added. The corresponding data are provided by the German federal statistical office. The monthly data on industry output and prices are converted into quarterly data to match the frequency of the bank lending data. While data on industry output are directly obtained for the sample period 1992:1-2002:4, information on industry prices is only available as of 1995:1. In order to identify the 1992:1-1994:4 values, we regress the industry-specific price index against a constant and the contemporaneous value of the aggregate price index and use the coefficient estimates from ordinary least squares (OLS) to extrapolate the missing values on industry-specific prices. Industry prices for the wholesale and retail trade, finance and insurance, transport and communication, and service sector are not available from the New Cronos database. Instead, we construct them using information on nominal and real value added from the German statistical office for the whole sample period 1992:1-2002:4.[35]

[34] The following sub-sectors are eliminated: (i) basic metals and fabricated metals products, (ii) machinery and transport equipment, (iii) electrical and optical equipment, (iv) wood and products of wood and cork; pulp, paper, and paper products.

[35] Note, the German statistical office reports data on nominal and real value added jointly for the (i) wholesale and retail trade sector and (ii) transport and communication sector. Unfortunately, we cannot disentangle the industry-specific price for each of these sectors, but have to rely on the composite price measure.

The New Cronos database and the Bundesbank quarterly borrower statistics occasionally differ in terms of industry aggregation. In particular, the borrower statistics tend to refer to composites of industries rather than to individual units. In order to adopt the same level of industry aggregation, the New Cronos data on industry production and industry characteristics are also combined across some industries. The composite indices are constructed by controlling for the relative importance of the single industries in the composite. Limited by data availability, the weights are approximated as the 1992-2002 ratio of annual value added of industry i to aggregate value added of the industries included in the composite. Since the weights are time-invariant, the use of the 1992-2002 average as weight seems to be innocuous.

In order to ensure the reliability of the empirical results, the quarterly data are screened along different lines. Firstly, the data are checked for outliers. Outlier detection concerns the relationship between variables as well as the distribution of variables. One relationship concerns the need of banks to meet their balance sheet constraint. For the requirement that total assets equal total liabilities, the study keeps all but 5 data points.[36] Another relationship is defined as the need to have positive entries for credit supply and total assets. In the present sample, at most 18 data points for industry-specific loans and 47 data points for total assets do not meet the non-negativity constraint. These observations are excluded from the sample.

As regards the distribution of variables, the outlier detection procedure is predominantly implemented for variables in levels. The exception concerns the volume of bank credit and total bank assets. In order to avoid the exclusion of very large and very small banks on the ground of sheer size, the outlier detection procedure for total assets and the volume of bank credit is implemented for their first log-differences.[37] Regardless of the variable, outliers are detected by using the sequential outlier rejection (SOR) algorithm described in Corney (2002). In contrast to standard methods like the z-score or box plot method, this outlier detection procedure adopts a sequential approach which accounts for the effect of outliers on the standard error in the sample. Furthermore, the SOR approach does not assume the normal distribution of banks at any point in time. This property is particularly valuable since the hypothesis of normally distributed banks can be rejected for all sampled variables (see Table 1 and Table 3).

The SOR algorithm requires the data to be repeatedly clustered using any clustering algorithm. The present analysis uses k-means clustering for each of the main banking groups, with $k = 2$.[38] For each repetition, the sum-squared error for k-means is computed, which describes the sum-squared deviation of each data point in the sample to the nearest clus-

[36] A data point is a single time observation associated with an individual bank (e.g., the observation associated with bank i in 1992:1).

[37] See Worms (2003) for a similar procedure.

[38] The large number of observations and computer limitations preclude the definition of more than two clusters.

ter center. The data point that contributes most to the sum-squared error for k-means is excluded from the sample. For each point in time and each banking group, the clustering algorithm is iteratively applied to the dataset. The number of iterations is roughly equal to 5 percent of the number of banks at each point in time.[39] That is, the first step of the procedure treats 5 percent of all banks at each point in time as potential outlier. The second step builds on the iteratively excluded observations from step one and determines the actual number of outliers by using the second difference of the sum-squared error term. Under the assumption that the sum-squared error rate is driven by outliers, the second derivative is close to zero and the cumulative sum thereof is constant for the sequence of data which excludes atypical observations. In the present study, we exclude any data point as outlier if it explains more than one percent of the cumulative sum of the second derivative. Similar to other outlier detection methods (e.g., the box plot method and the z-approach), the choice of threshold is arbitrary.

The analysis is confined to institutions which have the status of a monetary finance institute (MFI) throughout the whole sample period. The restricted focus is necessitated by a change in data definition. Until 1998:4, non-MFIs were treated as financial institutions and the Deutsche Bundesbank borrower statistics reported lending by these institutions to enterprises and households. As of 1999:1, non-MFIs are treated as enterprises and the borrower statistics do no longer report lending by, but credit supply to these institutions. In order to avoid that the definitional change of non-MFIs from being creditors to being debtors biases the results, we exclude banks with a non-MFI status in any quarter during the sample period. This leads to a loss of 1400 data points from the commercial banking group and 208 data points from the cooperative banking group.

6 Empirical Results

This section reports the empirical results of the fixed effects dynamic panel estimation. In section 6.1, we first describe the different samples for which the benchmark model (1) is estimated. Section 6.2 then reports ANOVA test statistics that help to structure the analysis of the empirical results from the dynamic panel in section 6.3. We conclude the present section with robustness tests of the benchmark model (1).

6.1 Sample Overview

The empirical model is estimated for different combinations of banking groups. Table 4 summarizes the composition of the samples. One sample jointly includes the primary (local) institutions of the commercial, savings, and credit cooperative sector. This group is subse-

[39] The number of iterations depends on the availability of data for a given banking group at a particular point in time. The results are not sensitive to a larger number of iterations.

quently referred to as the aggregate banking group. Group-specific effects are captured with banking group dummies for the savings and commercial banking group. Because the dummies turn out to be statistically insignificant in almost all specifications, weak or no banking group effects appear to exist for savings and commercial banks relative to credit cooperatives. In view of this finding, the subsequent evidence for the aggregate banking group refers to the results from estimations without banking group dummies. We also estimate the model for the credit cooperative banking sector, with banking dummies for the commercial credit cooperative banking group and Raiffeisen banks. In contrast to the aggregate banking group, the dummies turn out to be statistically significant for most industry bank lending functions.

In order to allow for the possibility of parameter heterogeneity across banking groups, another sample is separately defined for the three main sub-groups of the credit cooperative banking group (i.e., rural, commercial, and Raiffeisen banks) and for savings banks. The importance of possible panel heterogeneity is suggested by the ANOVA evidence in section 3.1 that points to structural differences between (i) the savings and cooperative banking group and (ii) the sub-groups of the cooperative banking sector. When estimating individual models for the savings and credit cooperative banking group, we assume cross-bank homogeneity in the interest rate elasticity of loan demand and hence cross-bank similarities in the distribution of bank-dependent and bank-independent customers within each individual banking group. We do not estimate an individual model for the commercial banking group or for the head institutions of the savings and credit cooperative banking sector because they operate product portfolios which differ from those of the local savings and credit cooperative banks. Besides, estimates for an individual sample of commercial banks are not reported since the number of cross sections is low. The fixed number of observations causes the fixed effects estimator and the robust covariance matrix estimates to be inconsistent although T is relatively large.

6.2 Analysis of Variance Tests

The representation of the results is complicated by the cross-sectional dimension of the study. To condense the analysis, this section first reports test statistics of one- and two-way analyses of variance which illustrate the sensitivity of the results to the choice of bank characteristic, the choice of aggregate and short-term lending, and the choice of industry and banking group. The test statistics are computed for the long-run coefficients of model (1) irrespective of the significance properties of the coefficient estimates. If we would confine the analysis to industries for which significant estimates are reported, ANOVA would not be feasible. Despite the inclusion of insignificant estimates, the results are still deemed to be illustrative. On the one hand, we only compute test statistics for variables for which most industry-specific long-run estimates are statistically significant, i.e., for industry output growth, industry inflation, and the interest rate change. Test statistics are not reported for the interaction terms because of pronounced differences in their statistical significance across the different bank lending specifications. On the other hand, the insignificant industry-specific coefficient estimates on either industry output growth, inflation, or the interest rate change compare well with the significant estimates in terms of sign and magnitude regardless of the choice of bank characteristic.

We first investigate whether the long-run coefficient estimates for industry output growth, inflation, and the interest rate change are influenced by the choice of bank characteristic, i.e., bank asset size, capitalization, broad/narrow liquidity, or short-term interbank claims. Because the results from the one-way analysis of variance are robust to the choice of banking group and do not differ for aggregate and short-term lending, we only report the results for the aggregate banking group and for short-term lending.[40] The results in Table 5 (columns 3 to 6) show that the null hypothesis of equal coefficients across bank characteristics cannot be rejected. The choice of bank characteristic hence does not significantly affect the long-run sensitivity of bank lending with respect to either industry-specific bank credit demand or the money market interest rate.

We next ask whether the long-run coefficients of the sampled variables depend on the choice of aggregate and short-term bank lending. Because the coefficient estimates are insensitive to the choice of bank characteristic, we only report the one-way ANOVA test statistics for bank asset size. The evidence in Table 5 (columns 7 to 10) points to the equality of the long-run coefficients of industry output growth and interest rate changes for aggregate and short-term lending. Considering inflation, conclusions regarding the determinants of bank lending growth differ for aggregate and short-term credit. The discrepancy in the long-run coefficients is attributable to the sub-sectors of the manufacturing sector.[41]

We conclude the discussion by formally testing whether differences in the bank lending effects are accounted for by banking groups or by industries. To this end, we compute the test statistics of a two-way analysis of variance. Given the one-way ANOVA test statistics, we only report the results for short-term lending and bank asset size, noting that the evidence for aggregate lending and the remaining bank characteristics does not differ.[42] Table 6 summarizes the results. The analysis of variance shows that differences in the responsiveness of short-term bank lending growth to industry output growth and industry inflation are attributable to industries, but not to banking groups.[43] That is, the evidence stresses discernible industry dissimilarities in the bank lending effects of industry output growth and inflation.

[40]The results for the remaining banking groups are available on request.

[41]Despite differences in the long-run response of short-term and aggregate lending to industry inflation, we only discuss the evidence for short-term lending to conserve on space. The results for aggregate lending are available on request. Note, ANOVA tests for the main industries only do not find significant differences in the long-run coefficients of industry inflation for aggregate and short-term lending.

[42]The ANOVA test statistics for estimations with bank capitalization, liquidity, and interbank assets and for aggregate lending are available on request.

[43]We replicate the analysis of variance for a sample that excludes the construction sector. The restricted focus is motivated by the unexpected positive interest rate response of bank lending to this industry. We find the ANOVA results to be robust to this sample adjustment.

In contrast to output growth and inflation, differences in the long-run bank lending effects of interest rate changes are explained by banking groups and industries. However, industry effects appear to be the more important source of variation in the bank lending effects of monetary policy. This conclusion builds on the observation that the F-value for the industry effect exceeds the corresponding value for the banking group effect.

The ANOVA evidence illustrates that industries are the more important source of differences in the bank lending effects of industry credit demand and monetary policy. In addition, we find the results regarding the bank lending effects of industry output growth, industry inflation, and monetary policy to be insensitive to the choice of aggregate and short-term lending. Motivated by these findings and to condense on space, the following section presents and discusses the empirical panel evidence on the determinants of industry-specific short-term bank lending growth for the aggregate banking group.

6.3 Evidence from Industry-Specific Bank Lending Functions

The empirical evidence from the benchmark model (1) is discussed in two parts. In a first step, we report the response of bank lending growth to changes in bank credit demand (i.e., industry output growth, industry inflation) and to changes in the money market interest rate. We then discuss the interaction terms between bank characteristics and monetary policy to draw conclusion as to the existence of credit channel effects of monetary policy through bank lending. Table 7 summarizes the coefficient estimates for the industry-specific bank lending functions.

(i) The Bank Lending Effects of Loan Demand and Monetary Policy

We report evidence for individual industries and for the grand total of industries. The evidence for the grand total of industries is our benchmark in the discussion of the industry-specific bank lending functions. Besides, when emphasizing the results for the grand total of industries, we can compare the present empirical findings with the evidence of earlier studies which do not adopt an industry-specific focus. In order to facilitate the readability of the results, we label industries by using abbreviations. For example, the finance and insurance industry is subsequently introduced as finance sector and the transport and communication sector is referred to as transport sector. Appendix A provides details. Because the evidence in section 6.2 shows that the choice of bank characteristic does not affect the long-run sensitivity of bank lending with respect to industry output growth, industry inflation, or the money market interest rate, we provide a general discussion of the results regarding the industry-specific bank lending effects of bank credit demand and monetary policy.

Considering the response of bank lending growth to industry output growth, the entries in Table 7 illustrate that bank lending to the grand total of industries increases in response to higher output growth. The positive output response of lending to the grand total reflects the statistically significant and positive response of lending to growth in agriculture, construction, trade, services, and the food manufacturing sector. At least for the construction sector, the positive reaction of bank lending is influenced by the 1992-1995 re-unification construction boom period that induced heavy investment. Opposite relationships exist for total manufacturing and for the sub-sectors of the manufacturing industry. This suggests that manufacturing firms demand less bank credit in response to output growth.[44] Possible reasons are (i) higher internal flows of finance, which reduce external financing needs and/or (ii) the absence of promising future economic prospects, which yield disincentives for investment. The relevance of the second point is suggested by the continuous decline in the share of manufacturing value added in aggregate value added during the last decade.[45] Next to the manufacturing industry, we also find an inverse relationship between bank lending growth and output growth for the finance sector. In contrast to the manufacturing industry, the finance sector accounts for an increasingly larger share of aggregate value added. The decline in bank lending may therefore reflect the effect of higher internal cash flow and the consequent lower need for bank finance.

As regards the response of bank lending growth to inflation, it is significant and positive for the grand total of industries. The positive reaction of bank lending to the grand total of industries reflects the positive response of bank lending to almost all industries. The exceptions are the transport and machinery and transport equipment manufacturing sector. In contrast to expectations, bank lending to these sectors significantly contracts in response to higher industry inflation.

Turning to the interest rate response of bank lending, the evidence confirms the view that higher interest rates cause lending to the grand total of industries to contract. The decline in bank lending reflects the negative effect of higher interest rates on bank reserves and credit rationing on the part of banks in response to an increase in the risk of loan default. The evidence in Table 7 also illustrates that this response is a weighed average of the interest rate reaction of all industries. We find unanimous cross-industry differences in the nature of the interest rate response of bank lending. On the one hand, the negative interest rate response of lending to the grand total of industries reflects lower bank credit supply to the energy, manufacturing, and transport industry, with the interest rate effect being most pronounced for the first two sectors. We attribute the strength of the effect for the energy and manufacturing industry to the comparatively high capital intensity of production, which is associated with a higher probability of loan losses (cf. Deutsche Bundesbank, 1996). For the manufacturing sector, the decline in lending reveals the negative interest rate effects of bank credit supply to the chemicals and coke, rubber and plastic, and textiles producing sector. At least the textiles producing sector is again more capital-intensive in comparison to the remaining industries.

[44] Also see Deutsche Bundesbank (1996) for a similar conclusion.

[45] The ratio of value added for manufacturing to value added for the grand total of industries declined from 0.26 in 1992 to 0.22 in 2002.

On the other hand, a monetary policy contraction induces higher lending to the construction, trade, and finance industry and to producers of non-metallic mineral goods. The positive interest rate response of lending to construction is not consistent with expectations. However, it can be explained with the structural and cyclical characteristics of the construction sector. As regards the structural properties, the construction industry is characterized by a large share of small firms, which predominantly obtain bank credit from local credit cooperatives and regional savings banks.[46] Knowledge of local market conditions and local debtors reduces information asymmetries and fosters housebank relationships. Housebank relationships, in turn, facilitate the access to bank finance in general and in periods of high interest rates and low demand in particular. Considering cyclical factors, the positive interest rate response of bank lending reflects the demand-driven re-unification boom in construction. Even during the 1991-1992 period of high interest rates, demand for residential buildings and production plants was high and even continued to increase.

The positive interest rate response of bank lending to the finance industry can be explained in terms of risk considerations. To explain, a contraction in monetary policy increases the probability of loan default of firms in all industries. While the riskiness of firms in all industries increases, banks may perceive firms in the finance sector to be less risky because they are exposed to more stringent financial regulation and supervision than firms in the non-financial sector. In view of this relationship, the positive interest rate response of lending to the finance and insurance sector may describe the effort of banks to channel a larger share of their bank credit portfolio towards relatively less risky firms in the finance sector.

The entries in Table 7 point to pronounced cross-industry differences in the magnitude of the bank lending effects of output growth, inflation, and interest rate changes. The largest response of bank lending to changes in monetary policy, industry inflation, and output growth is observed for the sub-sectors of the manufacturing industry. Indeed, bank lending to these sectors tends to be more responsive than bank lending to the manufacturing aggregate or to the grand total of industries. Next to the sub-sectors of the manufacturing industry, bank lending also responds comparatively strongly to output growth in the finance industry and to inflation in the construction and energy sector. The finance, construction, and energy industry and the sub-sectors of manufacturing have in common that the share of credit to these sectors is comparatively small (cf. Table 3). Bank lending thus seems to be more responsive to output growth and inflation in industries that only account for a small share of a bank's loan portfolio. This in turn suggests that banks primarily re-distribute credit between industries to which bank lending is relatively small and that the overall industry composition of a bank's loan portfolio is accordingly comparatively stable.

Overall, the evidence illustrates that the use of bank-level data on lending to the grand total of industries (i.e., aggregate lending) only provides an imperfect view on the bank lending effects of credit demand and monetary policy. Our results indicate that the direction and

[46] Also see section 3.2.

strength of aggregate bank lending effects depends on the industry structure of bank credit portfolios. This finding is particularly interesting for the definition of monetary policy as it shows that the effectiveness of monetary policy depends on industry structure.

(ii) Are there Bank Lending Effects of Monetary Policy?

So far, the discussion has focused on the direct effects of monetary policy. This section analyzes the empirical results for the interaction between bank characteristics and monetary policy in order to identify the distributional effects of monetary policy on industry-specific bank lending. As will become evident, conclusions as to the existence of cross-bank differences in the interest rate response of bank lending are sensitive to the choice of bank asset size, capitalization, liquidity, and short-term interbank claims.

The analysis of the interaction terms is subject to a shortcoming. As stated, the significance properties of the interaction terms preclude tests regarding the relative contribution of industries and banking groups as source of variation. Visual inspection of significant interaction terms points, however, to considerable differences in the sign and magnitude of the underlying credit channel effects across industries as well as banking groups. The differences are such that a separate discussion of the coefficient estimates of all interaction terms is valuable in its own right. However, this is beyond scope given the large number of industry-specific bank lending models by bank characteristic, banking group, and loan maturity. We can only acknowledge that conclusions regarding the credit channel effects of monetary policy depend on the choice of model specification and stress the interaction terms for short-term bank lending growth for the aggregate banking group.

Existing studies question the usefulness of capitalization and liquidity as proxy variables of the bank lending effects of monetary policy. Gambacorta and Mistrulli (2004) argue that the capital-to-asset ratio is an inappropriate measure of bank capitalization. The reason is that bank capital does not illustrate the riskiness of a bank's portfolio. It therefore does not correctly describe the severity of information asymmetries which, however, determines the ability of banks to obtain non-reservable funding. Kashyap and Stein (2000) contemplate that liquidity may provide a distorted view on the importance of bank balance sheet effects. This is because liquidity is also determined by cash that banks cannot freely use since it is subject to reserve requirements. Furthermore, Worms (2003) notes that bank lending reflects the liquidity preferences of banks, with more liquid banks lending less. If this holds, cross-bank differences in the interest rate sensitivity of bank lending are not uniquely attributable to cross-bank differences in liquidity. We only mention these weaknesses associated with some bank characteristics, but do not control for them for two reasons. Firstly, the share of cash in total assets relative to other liquidity components is low. Secondly, quarterly data on the riskiness of capital are not available in the present dataset. Even though capitalization and liquidity might be imperfect identifiers of bank credit supply effects of monetary policy, we report the results for these bank characteristics because we still assume that these variables influence the response of bank lending to interest rate changes.

Table 7 contains the industry-specific bank lending effects of monetary policy associated with cross-bank differences in asset size, capitalization, liquidity, or short-term interbank claims. Conclusions regarding the bank lending effects of monetary policy transmission are sensitive to the choice of bank characteristic and vary with the choice of industry. The evidence lends strong support to the existence of bank size effects in monetary policy transmission. For the grand total of industries and for almost all sampled industries, a monetary policy contraction causes bank lending of large banks to adjust less than bank credit of small banks. That is, large banks are better able to insulate their lending activities against monetary-policy-induced changes in the availability of reservable and non-reservable funds of finance. Inconsistent with the credit channel theory, the interest rate response of bank lending to the finance industry is more pronounced for large than for small banks. This finding possibly reflects the importance of commercial banks as source of lending to the finance industry (cf. Table 3) and the fact that commercial banks are on average larger in terms of asset size than savings banks and credit cooperatives (cf. Table 1). Insignificant effects are recorded in estimations for the construction and transport sector and for the non-metallic goods producing sector.

In contrast to bank asset size, cross-bank heterogeneities in capitalization do not explain cross-bank differences in the interest rate sensitivity of bank credit to the grand total of industries and to most individual industries. The exception is lending to agriculture, finance, services, and manufacturing. Except for the agricultural sector, better capitalized banks adjust lending less than poorly capitalized banks. The insignificance of bank capitalization lends support to the view that a risk-unadjusted measure of capitalization may imperfectly approximate the degree of information asymmetries.

Cross-bank asymmetries in the monetary policy response of bank lending to some industries are also attributable to cross-bank heterogeneities in the share of liquid assets. As discussed, the liquidity effects of monetary policy are separately identified for a broad and narrow measure of liquidity and for short-term interbank claims in order to determine whether short-term interbank claims affect the bank lending effects associated with liquidity. The evidence shows that broad and/or narrow liquidity significantly attenuates the interest rate response of lending to the grand total of industries and to the agricultural, construction, trade, transport, textiles, and food industry. The evidence lends comparatively weak support to the role of short-term interbank claims as determinant of the liquidity effects of monetary policy. Indeed, significant short-term interbank effects are confined to very few industries: construction, trade, and transport. This suggests that short-term interbank claims are a weak driving source of liquidity effects. In addition, because interbank claims are insignificant in explaining the interest rate response of credit supply to industries for which bank asset size possesses explanatory power, bank asset size appears to capture the bank lending effects of information asymmetries. That is, the evidence in the present study does not lend support to the finding of Worms (2003) according to which interbank claims dwarf the effects associated with bank asset size.

Comparing the magnitude of the distributional effects of monetary policy, differences prevail across bank characteristics. Indeed, cross-bank asymmetries in the interest rate response of bank lending are least pronounced for bank asset size and most pronounced for estimations with bank capitalization and short-term interbank claims. The evidence hence reveals that bank size is not the main determinant of cross-bank differences in the response to monetary policy changes. However, the relative importance of the capitalization effect should not be overemphasized because we define capitalization without correcting for bank risk. Besides these results, the entries in Table 7 suggest that the strength of bank lending effects of monetary policy differs between industries. In contrast to direct monetary policy effects, the cross-industry differences appear to be unrelated to the relative weight of industries in a bank's credit portfolio.

Table 7 also reports the one-period lags of the bank characteristics. Even though the coefficients do not have an intrinsic meaning, they illustrate in combination with the direct interest rate effect whether bank characteristics or monetary policy changes drive the significance of the interaction terms. The evidence tends to be mixed. For the grand total of industries, the significance of the coefficient on the interest rate change and the short-run bank characteristic illustrates that the significance of the interaction term is attributable to the direct bank lending effect of monetary policy and to cross-bank differences in any of the bank characteristics. For the industry-specific bank lending functions, the distributional effects of monetary policy are determined by either monetary policy or bank characteristics, by both variables, or by none. For example, the significance of the interaction term on asset size and capitalization in the estimation for total manufacturing is driven by the direct effect of monetary policy but not by bank characteristics. For the transport sector, the absence of credit channel effects in estimations with asset size seem to be driven by asset size given the evidence in favor of significant interest rate effects.

Overall, the evidence lends comparatively weak support to the transmission of monetary policy changes through bank lending. The conclusions as to the bank lending effects of monetary policy are sensitive to the choice of industry. This in turn points to the existence of industry effects of monetary policy through bank lending. In view of this finding, studies for the grand total of industries are likely to provide an incomplete view on the bank lending effects of monetary policy.

(iii) Cross-Study Comparison of the Results

For the grand total of industries, our evidence can be compared with that of existing studies. The present results for the grand total of industries match those in Ehrmann et al. (2003) and Worms (2003) only partly. One possible source of divergence are differences in the definition of bank credit. While the earlier studies define bank credit for lending to households and the grand total of industries, we do not include household lending.[47] Another source of heterogeneity concerns the outlier adjustment procedure. Ehrmann et al. (2003) and Worms (2003) identify outliers by assuming the normal distribution of banks, while we allow for skews in the distribution. The studies thus define outliers along different lines, which leads to the exclusion of different observations. The most striking difference, however, concerns the estimation methodology. Earlier studies estimate the dynamic panel model with GMM. We find this estimator to be inapplicable. Neither for the long sample period 1992-2002 nor for the short sample period 1992-1998 as used by Worms (2003) do we find valid over-identifying restrictions for our set of GMM estimations. We do not estimate the model for the short sample period with the fixed effects estimator because the finite sample bias would be stronger.

Our results are in line with those of Ehrmann et al. (2003) according to which bank lending grows in response to output growth and inflation and declines in the wake of monetary contraction. Furthermore, the present results are consistent with those in Ehrmann et al. (2003) according to which cross-bank differences in the interest rate sensitivity of aggregate bank credit cannot be attributed to differences in capitalization, but to differences in liquidity. However, the present study reports evidence that lends support to the existence of bank size effects in monetary policy transmission. In contrast to Worms (2003), the size effects are not driven by interbank claims since they also prevail in estimations which do not control for interbank claims.

(iv) Synthesis

Summarizing the results of the industry-specific bank lending functions, the evidence shows that bank lending growth is industry specific, being driven by cyclical changes in industry output growth and industry inflation and hence by factors of industry-specific bank credit demand. We find significant differences in the bank lending effects of industry output growth, industry inflation, and monetary policy changes between industries. Furthermore, regardless of the industry, the evidence lends weak support that banks differ in their lending response to monetary policy changes. If at all, cross-bank differences in the monetary policy response of bank lending are primarily attributable to bank asset size effects. Overall, it appears that bank

[47] Ehrmann et al. (2003) and Worms (2003) do not report evidence for short-term lending but for aggregate bank credit. Because our results for aggregate and short-term lending do not differ, we generalize our results when comparing them with earlier studies and do not make a distinction between short-term and aggregate lending.

lending growth predominantly depends on bank credit demand and on the relative importance of industries in a bank's loan portfolio.

6.4 Robustness Tests

In order to determine the robustness of the empirical findings, we modify the structure of the benchmark specification (1) along several lines. Table C.1 in appendix C summarizes the different models. To conserve on space, we only provide a verbal description of the corresponding evidence.[48] One set of estimations eliminates output growth and inflation from the benchmark model to test whether industry demand factors dwarf the bank lending effects of monetary policy changes. The test is motivated by the evidence from the benchmark model according to which bank lending growth is predominantly determined by industry output growth and industry inflation rather than by monetary policy. The results for the modified model confirm those for the benchmark specification. We find the magnitude of the direct monetary policy effects on bank lending to be in the range suggested by the benchmark specification. The evidence in favor of credit channel effects of monetary policy through bank lending is still comparatively strong for asset size, but relatively weak for the remaining bank characteristics. Furthermore, the coefficient estimates from the augmented specification closely resemble those from the benchmark model.

Another set of estimations re-estimates the benchmark model with more than one bank characteristic. One specification interacts each bank characteristic individually with monetary policy (Table C.1, model B), while a second model interacts two bank characteristics with each other as well as with monetary policy (Table C.1, model C).[49] We include more than one bank characteristic simultaneously to control for the possibility that models with only one bank characteristic report evidence that also captures the effects associated with other characteristics. More precisely, we take into account the likely interdependence between bank asset size and liquidity and bank capitalization and liquidity: large or better capitalized banks might be more liquid than small or poorly capitalized banks. For Germany, the interdependence may also extend to asset size and interbank claims. Worms (2003) and Ehrmann et al. (2003) have shown that interbank claims attenuate the effects of asset size and dominate the liquidity or capitalization effects of monetary policy. Although the present evidence illustrates that asset size explains the average interest rate response of banks in estimations which do not control for interbank claims, interbank claims may still capture part of the size effects. However, when including more than one bank characteristic, the models with single

[48]The coefficient estimates for all robustness tests are available on request. Note, existing studies on the bank lending effects of monetary policy also test for the differential response of bank lending by eliminating the effect of time-variant variables on bank lending with either time dummies or macroeconomic variables (cf. Gambacorta, 2003; Ehrmann et al., 2003; Worms, 2003). We abstain from capturing time effects with time dummies since they capture the level effect of those variables we are particularly interested in, i.e., monetary policy and the proxy variables of bank credit demand.

[49]See Ehrmann et al. (2003) and Worms (2003) for a description of the model.

and double interactions yield evidence which largely confirms the findings of the benchmark specification. Bank lending growth is predominantly determined by bank credit demand and not by monetary policy or the distributional effects of monetary policy. The strength of the underlying effects significantly differs between industries.

The evidence from the model with more than one single interaction term (Table C.1, model B) suggests the independence of the effects associated with each single bank characteristic. For example, when significant, the effects associated with bank capitalization are still comparatively strong, while bank size effects are relatively small. In fact, the strength of significant bank size, capitalization, liquidity, and interbank effects does not vary much between the benchmark and augmented model. We therefore conclude that distributional effects of monetary policy reveal size and capitalization effects which are not driven by interbank claims or bank liquidity. Similarly, interbank assets do not influence the evidence on bank liquidity effects. For most bank lending functions, interbank assets are statistically insignificant and broad liquidity effects reflect the effects associated with narrow liquidity.

The model with double interaction terms (Table C.1, model C) tests whether cross-bank differences in the interest rate response of bank lending depend on the interdependence of effects associated with (i) interbank claims and either bank asset size, capitalization, or liquidity and (ii) liquidity and either bank asset size or capitalization. The hypothesis is that the effect of interbank claims or liquidity on the interest rate response of bank lending is smaller for large and better capitalized banks. Summarizing the results, we find the double interaction terms to be statistically insignificant in almost all industry bank lending functions. The only significant responses are recorded for estimations with interbank claims and either asset size, capitalization, or narrow liquidity. When significant, the evidence tends to be inconsistent with expectations: interbank effects on bank lending are smaller for (i) small banks (machinery and transport equipment sector), (ii) poorly capitalized banks (electrical and optical equipment sector), and (iii) less liquid banks (construction, services, wood and paper producing sector). Anticipated relationships prevail for the grand total of industries. We find the interbank effects of monetary policy on bank lending to be smaller for large banks. In addition, interbank effects are smaller for liquid banks in estimations for the rubber and plastic and machinery and transport equipment sector.

As an alternative test we ask whether the results are sensitive to the way we define the explanatory variables of the benchmark specification. The model in equation (1) includes industry-specific bank lending, output, and inflation without weighing each of these components by the corresponding bank-specific aggregate. In expressing loans in absolute terms, we follow Kishan and Opiela (2000), Gambacorta and Mistrulli (2004), Ehrmann et al. (2003), Worms (2003), Hülsewig, Mayer, and Wollmershäuser (2005), among others. In reality, banks operate portfolios, with lending to industry i being part of a diversification strategy. The relative importance of industries in a bank's portfolio hence differs. In order to control for differences in the importance of industries, we redefine the industry-specific variables relative to the aggregate (Table C.1, model D). Doing so, we do not only control for differences in the relative importance of industries, but also for structural breaks which result from redefinitions in the composition of industries. Furthermore, we can also control for the effect of those mergers which do not appear as outliers. When using ratios, merger-driven jumps in lending are ameliorated or even eliminated. The results do not differ qualitatively from those of the benchmark specification: bank lending growth is determined by bank credit demand rather than by monetary policy. Conclusions regarding the distributional effects of monetary policy on bank lending do not differ much between the base and augmented specification.

So far, the robustness checks involve structural changes of the base specification, using data for the sample period 1992:1-2002:4. This sample period captures years of exceptional circumstances as caused by German re-unification. Particular to this process is above average credit demand by all industries (cf. Deutsche Bundesbank, 1996). In order to assess the sensitivity of the results to re-unification effects, we also estimate the benchmark specification for the period 1995:1-2002:4 (Table C.1, model E). For almost all industries, the results for the shorter time period do not differ qualitatively from those obtained for the longer time period. The only exception is the manufacturing industry. In contrast to the long sample period, bank lending to this sector is predicted to expand in response to industry inflation and to contract in reaction to higher interest rates. Conclusions regarding the existence of bank lending effects of monetary policy also change for bank asset size. In contrast to the long sample, the interest rate response of bank lending does no longer decrease with asset size, but increases. The relationships for output growth and the remaining bank characteristics do not change. The evidence for manufacturing is hence influenced by German re-unification. Visual inspection of the data shows that the results are driven by differences in the time-series pattern of inflation during 1992-1993 and 1994-2002. Manufacturing prices were constant during 1992-1993, while the share of short-term credit to manufacturing declined. Manufacturing prices only increased as of 1994.

Overall, conclusions as to the response of bank lending to changes in monetary policy and bank credit demand are robust to alternative model specifications. Regardless of the model, we find strong evidence that credit supply effects of monetary policy are small. Significant cross-industry differences still prevail, which demonstrates that the sensitivity of a bank's credit portfolio to monetary policy changes or economic conditions clearly depends on the industry composition of a credit portfolio.

7 Conclusion

This paper has used a unique dataset with bank-level data on bank balance sheet items and bank industry lending to investigate the bank lending effects of bank credit demand and monetary policy for Germany over the period 1992:1-2002:4. In contrast to existing work on the credit channel effects of monetary policy, we explicitly focused on the industry effects of bank lending and estimated bank lending functions for eight industries at the one-digit industry level and for five sub-sectors of the manufacturing industry at the two-digit industry level. The bank lending functions were defined for aggregate and short-term lending and for five individual banking groups. In line with existing studies, we used bank asset size, capitalization, liquidity, and short-term interbank claims as proxy variables of cross-bank differences in the severity of information asymmetries.

Our empirical findings lend strong support to the existence of industry effects of bank lending: industries are the more important source of variation in the bank lending effects of bank credit demand and monetary policy, with strong effects arising from industry output growth and industry inflation. Banking group effects are comparatively weak. This in turn suggests that the institutional setting of the German banking system might be a relatively unimportant determinant of bank lending growth. The evidence lends mixed support to the credit channel theory according to which cross-bank differences in the interest rate response of bank lending can be explained with cross-bank heterogeneities in bank asset size, capitalization, liquidity, and short-term interbank claims. Again, the conclusions are very sensitive to the choice of industry and also depend on the choice of bank characteristic and banking group. We conclude that the credit channel effects of monetary policy through bank lending are weak and that the industry composition of bank credit portfolios determines bank lending growth and - more important from an economic policy perspective - the effectiveness of monetary policy.

We expect that the evidence in favor of industry effects of bank lending would also prevail in estimations which solve one major limitation of the present analysis. We estimated a reduced-form model which imposes the simplifying assumption that monetary policy does not immediately affect bank credit demand, but only bank credit supply. That is, we do not control for the sensitivity of loan demand to monetary policy changes. Of course, bank credit demand is likely to respond to monetary policy changes because of, for example, balance sheet effects. Unfortunately, we can only acknowledge, but not address this shortcoming.

Annex A Data Sources and Descriptions

The following overview lists the industries for which data on economic activity and prices are compiled. The second column labels the industry as it will be abbreviated throughout the paper.

Industry	Abbreviation	Source
Grand total		NC
Mining and quarrying; Electricity, gas, and water supply	Energy	NC
Total manufacturing		NC
Food products, beverages and tobacco	Food	NC
Textiles and textile products	Textiles	NC
Wood and products of wood and cork	Wood	NC
Pulp, paper, paper products, printing, and publishing	Paper	NC
Coke, refined petroleum products, and nuclear fuel	Coke	NC
Chemicals and chemical products	Chemicals	NC
Rubber and plastics products	Rubber and plastic	NC
Other non-metallic mineral products	Non-metallic mineral	NC
Basic metals and fabricated metal products	Metals	NC
Machinery and equipment, n.e.c.	Machinery	NC
Electrical and optical equipment	Electrical equipment	NC
Transport equipment	Transport equipment	NC
Construction	Construction	NC
Agriculture, forestry, and fishing	Agriculture	GSO
Services	Service	GSO
Wholesale and retail trade, repairs	Trade	GSO
Transport and communication	Transport	GSO
Finance and insurance	Finance	GSO

Note: NC = New Cronos database of Eurostat, GSO = German statistical office.

The empirical analysis does not include all industries individually, but also combinations of sectors. An aggregation of sectors is necessitated by the definition of industry sectors in the Bundesbank borrower statistics. The following industries are treated as a single unit: (i) wood and paper; (ii) coke and chemicals; (iii) machinery and transport equipment.

With few exceptions, monthly data on the industry production index and industry price index are compiled from the New Cronos database of Eurostat (NC). The monthly data are converted into quarterly data. Industry data on agriculture, services, wholesale and retail trade, finance and insurance, and transport and communication are obtained from the German statistical office (GSO).

Data on bank characteristics are compiled from the Bundesbank's monthly bank balance sheet statistics. The following variables are used:

- Total assets (TA)
- Bank capital (K)
- Liquidity (A)

Bank capital includes subscribed capital, reserves, capital represented by participation rights and the fund for general banking risk. Liquidity is defined as the sum of cash; balances with the central banks; treasury bills, treasury certificates, and similar debt instruments issued by public authorities (eligible for refinancing); debt securities; shares and other variable-yield securities; claims on credit institutions with an agreed maturity or redeemable at notice of one year or less (short-term interbank claims).[50]

Data on bank-specific lending to eight main industries and nine sub-sectors of the manufacturing industry are compiled from the quarterly borrower statistics of the Deutsche Bundesbank.

[50] The determinants of liquidity are ranked according to liquidity. From the top to the bottom, liquidity declines. See Büschgen (1998, chapter 4.B) for details.

Annex B Variable Description

The vector of bank characteristics X_b in equation (1) includes variables related to bank efficiency and profitability: total assets (TA), liquidity (A), and bank capital (K). In line with existing studies (cf. Ehrmann et al., 2003; Gambacorta and Mistrulli, 2004; Worms, 2003), the level of bank-specific capital Cap_b, broad liquidity $Bliq_b$, narrow liquidity $Nliq_b$, and short-term interbank claims Ibk_b is normalized with respect to the average across all banks and time according to

$$Cap_{bt} = \frac{K_{bt}}{TA_{bt}} - \frac{1}{T}\sum_{t=1}^{T}\left(\frac{1}{N_b}\sum_{b=1}^{N_b}\frac{K_{bt}}{TA_{bt}}\right), \tag{B.1}$$

$$Bliq_{bt} = \frac{A_{bt}}{TA_{bt}} - \frac{1}{T}\sum_{t=1}^{T}\left(\frac{1}{N_b}\sum_{b=1}^{N_b}\frac{A_{bt}}{TA_{bt}}\right), \tag{B.2}$$

$$Nliq_{bt} = \frac{A_{bt} - Ibk_{bt}}{TA_{bt}} - \frac{1}{T}\sum_{t=1}^{T}\left(\frac{1}{N_b}\sum_{b=1}^{N_b}\frac{A_{bt} - Ibk_{bt}}{TA_{bt}}\right), \tag{B.3}$$

$$Ibk_{bt} = \frac{Ibk_{bt}}{TA_{bt}} - \frac{1}{T}\sum_{t=1}^{T}\left(\frac{1}{N_b}\sum_{b=1}^{N_b}\frac{Ibk_{bt}}{TA_{bt}}\right), \tag{B.4}$$

respectively. The bank characteristics are expressed in terms of total assets to de-trend these series. To this end, we assume that bank capitalization, liquidity, and interbank claims follow similar trends as asset size. Total assets (TA) are also normalized with respect to the mean across all banks, but de-trending requires the normalization for each single data point. This yields the following measure of bank asset size

$$Size_{bt} = \log TA_{bt} - \frac{1}{N_b}\sum_{b=1}^{N_b}\log TA_{bt}. \tag{B.5}$$

Normalization with respect to the average across all banks means that the indicator variables Size, Cap, Bliq, Nliq, and Ibk sum to zero over all observations. Because of this property, the interaction terms in equation (1) in the main text are on average equal to zero. In addition, the coefficient estimate γ_{1j} directly reflects the average effect of monetary policy on bank credit growth.

Annex C Alternative Model Specifications

Table C.1 summarizes the main differences between the benchmark model and the alternative model specifications.

Table C.1: Summary of Model Specifications

- **Benchmark Model**
  Bank credit demand variables; Sample period 1992:1-2002:4; 1 single interaction term.
- **Augmented Model A**
  No bank credit demand variables; Sample period 1992:1-2002:4; 1 single interaction term.
- **Augmented Model B**
  Bank credit demand variables; Sample period 1992:1-2002:4; 3-4 single interaction terms (SIT).
  Model 1: SIT for Size, Cap, Bliq,
  Model 2: SIT for Size, Cap, Nliq,
  Model 3: SIT for Size, Cap, Ibk,
  Model 4: SIT for Size, Cap, Ibk, Nliq.
- **Augmented Model C**
  Bank credit demand variables; Sample period 1992:1-2002:4; 1 double interaction term (DIT).
  Model 1: DIT for Size, Ibk,
  Model 2: DIT for Cap, Ibk,
  Model 3: DIT for Nliq, Ibk.
  Model 4: DIT for Size, Cap.
- **Augmented Model D**
  Bank credit demand variables; Sample period 1992:1-2002:4;1 single interaction term; Relative model (see equation C.1).
- **Augmented Model E**
  Bank credit demand variables; Sample period 1995:1-2002:4; 1 single interaction term.

In order to control for the relative importance of industries in a bank's portfolio relative to the aggregate (panel D in Table C.1), the benchmark specification in equation (1) is rewritten as

$$\Delta\frac{L_{bi,t}}{L_{b,t}} = \alpha_b + \sum_{j=1}^{p}\beta_{ij}\Delta\frac{L_{bi,t-j}}{L_{b,t-j}} + \sum_{j=1}^{p}\gamma_{1j}\Delta r_{M,t-j} + \sum_{j=1}^{p}\gamma_{2,ij}\Delta\frac{IP_{i,t-j}}{IP_{t-j}} + \sum_{j=1}^{p}\gamma_{3,ij}\Delta\frac{Price_{i,t-j}}{Price_{t-j}} +$$
$$\gamma_4 X_{b,t-1} + \sum_{j=1}^{p}\gamma_5 X_{b,t-1}\Delta r_{M,t-j} + \epsilon_{bi,t}. \quad (C.1)$$

Annex D Tables

Table 1: Summary Statistics of Bank Balance Sheet Variables, 1992:1-2002:4

	N	Mean	Stdev	Skew.	Kurtosis
1. Assets					
Commercial BG					
• Big B.	144	19.98	0.44	-0.29	1.90
• Regional, Private B.	6,475	14.25	1.80	0.28	3.02
Savings BG					
• Land B.	571	18.74	1.02	-1.84	10.11
• Savings B.	25,200	14.69	0.94	0.06	3.02
Cooperative BG					
• Central Institutes	152	18.36	0.77	0.73	2.42
• Cooperative B.	96,785	12.63	1.06	0.41	3.32
Aggregate BG	128,604	13.12	1.40	0.61	3.58
2. Capitalization					
Commercial BG					
• Big B.	148	0.06	0.01	0.28	1.81
• Regional, Private B.	6,770	0.08	0.04	1.43	5.05
Savings BG					
• Land B.	592	0.03	0.01	0.55	2.88
• Savings B.	25,800	0.04	0.01	0.37	3.12
Cooperative BG					
• Central Institutes	156	0.03	0.01	0.50	3.66
• Cooperative B.	101,360	0.05	0.01	0.71	4.09
Aggregate BG	133,673	0.05	0.02	4.46	40.27
3. Liquidity					
Commercial BG					
• Big B.	148	0.20	0.04	0.51	2.53
• Regional, Private B.	7,433	0.29	0.18	0.84	3.70
Savings BG					
• Land B.	592	0.23	0.07	0.22	2.27
• Savings B.	26,552	0.32	0.10	0.84	3.78
Cooperative BG					
• Central Institutes	156	0.36	0.08	0.41	2.52
• Cooperative B.	101,831	0.28	0.10	0.72	3.76
Aggregate BG	135,829	0.29	0.11	0.79	4.54
4. Short-Term Interbank Claims					
Commercial BG					
• Big B.	148	0.03	0.01	0.26	2.43
• Regional, Private B.	6,817	0.06	0.07	1.41	5.06
Savings BG					
• Land B.	592	0.06	0.05	1.75	7.42
• Savings B.	25,851	0.03	0.04	1.77	7.02
Cooperative BG					
• Central Institutes	156	0.12	0.08	0.55	2.59
• Cooperative B.	101,183	0.05	0.05	1.72	7.02
Aggregate BG	133,158	0.05	0.05	1.66	6.40

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	N	Mean	Stdev	Skew.	Kurtosis
5. Lending to Non-Banks					
Commercial BG					
• Big B.	131	0.50	0.11	-0.95	3.40
• Regional, Private B.	3,395	0.55	0.20	-0.34	2.74
Savings BG					
• Land B.	568	0.40	0.09	-0.44	3.65
• Savings B.	20,386	0.61	0.10	-1.34	5.24
Cooperative BG					
• Central Institutes	156	0.17	0.07	-0.20	1.74
• Cooperative B.	91,683	0.60	0.11	-0.70	3.40
Aggregate BG	115,595	0.60	0.11	-0.85	4.09
6. Total Credit to Industries					
Commercial BG					
• Big B.	131	0.58	0.08	-0.68	3.12
• Regional, Private B.	3,043	0.54	0.25	-0.56	2.19
Savings BG					
• Land B.	568	0.45	0.09	-0.19	2.92
• Savings B.	20,350	0.45	0.08	-0.28	3.42
Cooperative BG					
• Central Institutes	156	0.65	0.16	-0.65	2.21
• Cooperative B.	91,309	0.46	0.13	-0.28	4.07
Aggregate BG	114,833	0.46	0.12	-0.19	4.44
7. Short-Term Credit to Industries					
Commercial BG					
• Big B.	131	0.40	0.10	-1.69	5.14
• Regional, Private B.	3,036	0.54	0.26	0.13	2.02
Savings BG					
• Land B.	568	0.16	0.09	5.40	48.64
• Savings B.	20,342	0.22	0.06	1.14	8.20
Cooperative BG					
• Central Institutes	156	0.33	0.09	0.65	4.93
• Cooperative B.	91,031	0.26	0.08	0.63	5.22
Aggregate BG	114,540	0.26	0.10	2.53	16.53

Notes: Assets (panel 1) are expressed in logarithm. The balance sheet positions capitalization (panel 2), liquidity (panel 3), interbank claims (panel 4), and total lending to non-banks (panel 5) are expressed as share of total assets. Lending to non-banks includes lending to domestic businesses, private households, government, and foreign non-banks. Lending to industries combines bank credit supply to businesses and self-employed. Aggregate lending to industries (panel 6) is expressed as share of total non-bank lending. Short-term lending to industries (panel 7) is expressed as share of aggregate lending to industries. The descriptive statistics for savings banks are for public rather than for private savings banks. The aggregate banking group only consists of the primary institutions of the commercial, savings, and cooperative banking group. The quarterly data are computed from the monthly bank balance sheet statistics of the Deutsche Bundesbank. N refers to the number of bank-quarter observations.

Table 2: One-Way ANOVA of Bank Balance Sheet Variables, 1992:1-2002:4

Variable	Source of Variation	SS	DF	MS	F-Value
Panel A: Main Banking Groups					
Assets	Between Groups	97,209	2	48,604	39,429*
	Within Groups	158,911	128,913	1.23	
Capitalization	Between Groups	7.10	2	3.53	19,356*
	Within Groups	24.46	133,982	0.000	
Liquidity	Between Groups	29.96	2	14.98	1,350*
	Within Groups	1,510	136,138	0.011	
Short-Term Interbank Claims	Between Groups	6.25	2	3.12	1,290*
	Within Groups	323	133,467	0.002	
Lending to Non-Banks	Between Groups	12.15	2	6.08	491*
	Within Groups	1,431	115,592	0.012	
Total Credit to Industries	Between Groups	20.52	2	10.26	676*
	Within Groups	1,744	114,830	0.015	
Short-Term Credit to Industries	Between Groups	99.81	2	49.90	13,897*
	Within Groups	411	114,537	0.004	
Panel B: Cooperative Banking Groups					
Assets	Between Groups	48,626	5	9,725	15,512*
	Within Groups	60,673	96,775	0.627	
Capitalization	Between Groups	0.24	5	0.047	493*
	Within Groups	9.66	100,942	0.000	
Liquidity	Between Groups	34.20	5	6.84	713*
	Within Groups	975	101,683	0.010	
Short-Term Interbank Claims	Between Groups	4.06	5	0.811	320*
	Within Groups	254	100,329	0.003	
Lending to Non-Banks	Between Groups	31.35	5	6.27	546*
	Within Groups	1,053	91,677	0.011	
Total Credit to Industries	Between Groups	416	5	83.30	7,491*
	Within Groups	1,015	91,303	0.011	
Short-Term Credit to Industries	Between Groups	42.39	5	8.28	3,457*
	Within Groups	218	91,025	0.002	

Notes: Assets are expressed in logarithm. Total and short-term credit to industries are expressed as share of non-bank lending. The remaining variables are expressed in terms of total assets. The main banking groups are the commercial banking group and the primary institutions of the savings and credit cooperative banking sector. The cooperative banking group comprises commercial and rural credit cooperatives, Raiffeisen banks, Sparda and PSD banks, and civil servants banks. The degrees of freedom related to the within groups variation refers to bank-quarter observations. * denotes the statistical significance at the one percent level, respectively. The quarterly data are computed from the monthly bank balance sheet statistics of the Deutsche Bundesbank.

Table 3: Summary Statistics of Bank Lending to Industries, 1992:1-2002:4

	Aggregate Lending					Short-Term Lending				
Lending to:	N	Mean	Stdev	Skew.	Kurtosis	N	Mean	Stdev	Skew.	Kurtosis
Agr										
Commercial BG	942	0.05	0.09	3.75	27.02	3,060	0.04	0.10	6.35	48.10
Savings BG	21,657	0.04	0.04	3.34	19.57	24,292	0.04	0.04	3.06	17.56
Cooperative BG	85,636	0.17	0.15	1.36	4.93	93,216	0.13	0.13	1.88	7.59
Enr										
Commercial BG	1,141	0.04	0.08	6.38	56.31	2,564	0.04	0.12	6.06	47.45
Savings BG	7,922	0.02	0.03	2.94	16.14	17,606	0.01	0.02	7.37	95.52
Cooperative BG	8,987	0.02	0.02	3.36	20.44	33,024	0.01	0.03	9.52	191.63
Con										
Commercial BG	1,648	0.06	0.04	1.92	10.27	3,916	0.06	0.06	2.38	14.02
Savings BG	23,390	0.11	0.04	0.95	4.76	25,030	0.15	0.06	1.00	4.84
Cooperative BG	86,792	0.13	0.06	1.72	12.13	94,296	0.17	0.10	1.35	6.64
Trd										
Commercial BG	2,754	0.24	0.19	2.10	7.53	5,308	0.33	0.27	1.23	3.69
Savings BG	23,406	0.21	0.05	0.56	5.19	24,939	0.25	0.08	0.54	4.23
Cooperative BG	88,148	0.19	0.08	1.18	11.15	94,422	0.22	0.11	0.98	7.19
Trt										
Commercial BG	1,320	0.05	0.08	4.25	23.75	3,960	0.03	0.05	4.13	28.94
Savings BG	22,768	0.04	0.02	3.13	23.98	24,720	0.03	0.03	4.06	37.58
Cooperative BG	67,973	0.04	0.04	3.57	38.74	83,667	0.03	0.06	63.72	8,349
Fin										
Commercial BG	3,416	0.05	0.08	4.95	37.49	5,088	0.11	0.35	24.50	925.41
Savings BG	24,264	0.01	0.01	3.60	28.41	24,392	0.01	0.01	8.79	149.53
Cooperative BG	62,873	0.01	0.02	18.58	650.47	70,116	0.01	0.03	19.00	600.86
Ser										
Commercial BG	3,416	0.45	0.19	0.46	2.94	5,367	0.42	0.98	64.95	4,565
Savings BG	23,575	0.40	0.10	0.16	2.96	25,031	0.31	0.12	0.61	3.54
Cooperative BG	91,368	0.30	0.13	1.01	6.33	95,445	0.25	0.15	1.41	6.85
Mfg										
Commercial BG	2,375	0.20	0.11	0.68	4.56	4,957	0.22	0.18	1.91	10.45
Savings BG	23,322	0.20	0.09	1.12	4.87	25,039	0.22	0.10	0.91	4.04
Cooperative BG	89,332	0.20	0.09	0.87	4.29	95,240	0.21	0.11	1.14	6.13

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Lending to:	Aggregate Lending N	Mean	Stdev	Skew.	Kurtosis	Short-Term Lending N	Mean	Stdev	Skew.	Kurtosis
C & C										
Commercial BG	1,414	0.02	0.02	4.53	36.19	2,958	0.04	0.12	8.43	92.07
Savings BG	12,365	0.01	0.01	2.94	15.19	14,576	0.01	0.02	5.59	53.80
Cooperative BG	18,463	0.01	0.01	3.96	30.32	26,186	0.01	0.02	5.88	56.66
R & P										
Commercial BG	1,509	0.01	0.01	3.37	21.60	2,374	0.02	0.07	10.30	123.91
Savings BG	17,890	0.01	0.02	2.65	13.51	19,863	0.02	0.02	3.93	28.01
Cooperative BG	34,205	0.02	0.02	3.35	21.13	41,671	0.02	0.03	5.11	61.45
Nmm										
Commercial BG	1,435	0.01	0.01	2.90	21.17	2,488	0.01	0.02	4.99	44.08
Savings BG	20,366	0.01	0.01	3.52	23.85	22,571	0.01	0.02	5.54	58.93
Cooperative BG	49,307	0.01	0.02	5.44	57.31	57,712	0.01	0.03	7.14	110.66
Bm										
Commercial BG	1,921	0.03	0.03	2.10	9.94	3,497	0.03	0.04	3.80	27.58
Savings BG	22,388	0.04	0.04	3.63	19.68	24,015	0.04	0.05	3.18	16.13
Cooperative BG	73,525	0.03	0.04	3.34	22.09	79,953	0.03	0.04	3.96	43.46
M & T										
Commercial BG	2,060	0.04	0.03	1.82	8.85	3,824	0.05	0.09	5.82	53.64
Savings BG	21,872	0.03	0.02	1.62	6.78	23,684	0.04	0.04	2.06	9.34
Cooperative BG	68,459	0.03	0.03	2.11	9.60	74,417	0.04	0.05	3.01	18.15
E & O										
Commercial BG	2,104	0.03	0.02	1.47	5.79	3,981	0.04	0.07	9.71	144.75
Savings BG	22,082	0.02	0.02	4.71	45.39	23,743	0.03	0.03	3.69	25.55
Cooperative BG	73,033	0.03	0.03	3.41	28.33	79,206	0.03	0.04	6.39	158.81
W & P										
Commercial BG	2,102	0.03	0.02	1.33	6.24	3,846	0.03	0.04	2.90	14.05
Savings BG	22,842	0.04	0.03	1.92	8.60	24,389	0.05	0.04	2.18	10.53
Cooperative BG	83,890	0.05	0.04	1.93	9.40	89,981	0.06	0.05	4.60	56.21
Txt										
Commercial BG	1,847	0.02	0.02	3.06	18.45	3,604	0.03	0.05	7.32	114.65
Savings BG	20,626	0.01	0.02	3.86	25.52	23,047	0.02	0.03	4.03	26.49
Cooperative BG	59,671	0.02	0.03	4.95	41.06	68,737	0.02	0.04	5.52	48.46
Fd										
Commercial BG	2,088	0.04	0.04	3.89	26.58	3,642	0.04	0.04	2.74	15.65
Savings BG	22,595	0.03	0.02	1.77	8.21	24,263	0.03	0.03	3.81	48.64
Cooperative BG	81,489	0.04	0.04	3.44	32.76	87,119	0.03	0.04	3.85	28.68

Notes: Agr = agriculture, Enr = energy and mining, Con = construction, Trd = wholesale and retail trade, Trt = transport and communication, Fin = finance and insurance, Ser = services, Mfg = manufacturing, C&C = chemicals and coke, R&P = rubber and plastic, Nmm = non-metallic mineral, Bm = metals, M&T = machinery and transport equipment, E&O = electrical and optical equipment, W&P = wood and paper, Txt = textiles, Fd = food. Aggregate (short-term) lending to industry i is expressed relative to aggregate (short-term) lending to the grand total of industries. The data are from the quarterly borrower statistics of the Deutsche Bundesbank. For each banking group, the sum of the means deviates from one due to rounding and due to the use of unbalanced sets of bank-quarter observations. Besides missing observations, the cross-industry differences in the number of bank-quarter observations also result from the removal of outliers (see section 5).

Table 4: Sample Overview

Bank Lending Functions for:	Banking Group Composed of:
• Aggregate banking group (BG) • Credit cooperative BG • Savings BG • Commercial credit cooperatives • Rural credit cooperatives • Raiffeisen banks	• Commercial, savings, credit cooperative banks • Commercial and rural credit cooperatives, Raiffeisen banks • Public savings banks

Table 5: One-Way ANOVA Test Statistics, Aggregate Banking Group

		Bank Charact. & Short-Term Lending				Type of Credit & Bank Asset Size			
	Source of Variation	SS	DF	MS	F-Statistic	SS	DF	MS	F-Statistic
Long-Run Coef.:									
ΔIP	Between Groups	0.044	4	0.011	0.003	0.016	1	0.016	0.006
	Within Groups	232	65	3.56		74.01	26	2.85	
ΔPrice	Between Groups	0.895	4	0.224	0.019	58.10	1	58.10	11.12*
	Within Groups	748	65	11.51		136	26	5.22	
ΔIR	Between Groups	0.0003	4	0.0000	0.158	0.000	1	0.0000	0.042
	Within Groups	0.030	65	0.0005		0.009	26	0.0004	

Notes: Columns 3 to 6 report the results for the hypothesis that the long-run elasticities do not differ between bank asset size, bank capitalization, narrow liquidity, broad liquidity, and short-term interbank claims. The ANOVA test statistics are reported for short-term lending by the aggregate banking group. Columns 7 to 10 report the results for the hypothesis that the mean values do not differ in estimations for aggregate and short-term bank credit. The corresponding evidence is reported for estimations with bank asset size as bank characteristic. In this table, the within groups variation refers to the variation between industries.

Table 6: Two-Way ANOVA Test Statistics, Short-Term Lending

Long-Run Coef.:	Source of Variation	SS	DF	MS	F-Statistic
ΔIP	Banking Group	7.44	3	2.48	0.72
	Industry	201	12	16.72	4.88*
ΔPrice	Banking Group	14.66	3	4.89	0.41
	Industry	316	12	26.34	2.19**
ΔIR	Banking Group	0.004	3	0.001	3.38**
	Industry	0.033	12	0.003	7.20*

Notes: The table reports the ANOVA test statistics for short-term lending. The results refer to estimations with bank asset size. The banking group involves savings banks, rural and commercial credit cooperatives, and Raiffeisen banks. The industry dimension includes 8 industries at the one-digit level and 5 manufacturing industries at the two-digit level. * denotes the statistical significance at the one percent level.

Table 7: Fixed Effects Long-Run Estimates for Short-Term Lending by the Aggregate Banking Group

	Grand Total of Industries					Agriculture				
Bank Characteristic:	Size	Cap	Bliq	Nliq	Ibk	Size	Cap	Bliq	Nliq	Ibk
Long-Run Coefficients										
ΔIP	0.539 *	0.648 *	0.473 *	0.489 *	0.659 *	0.257	0.336 **	0.234	0.207	0.180
	(0.100)	(0.101)	(0.101)	(0.100)	(0.104)	(0.158)	(0.161)	(0.159)	(0.159)	(0.161)
ΔPrice	3.535 *	3.247 *	3.482 *	3.490 *	3.621 *	0.462 *	0.604 *	0.478 *	0.422 *	0.412 *
	(0.206)	(0.213)	(0.211)	(0.207)	(0.215)	(0.135)	(0.140)	(0.137)	(0.136)	(0.139)
ΔIR	-0.023 *	-0.019 *	-0.020 *	-0.024 *	-0.025 *	0.001	0.001	0.004 ***	0.003 ***	0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Char*ΔIR	0.003 *	0.162	0.061 *	0.064 *	0.025	0.005 *	-0.734 *	0.084 *	0.074 *	0.030
	(0.001)	(0.112)	(0.013)	(0.013)	(0.027)	(0.001)	(0.213)	(0.023)	(0.024)	(0.049)
Short-Run Coefficient										
$Char_{t-1}$	0.015 *	-0.999 *	0.143 *	0.121 *	0.064 *	-0.014 *	0.286	0.018	0.052 **	-0.043
	(0.002)	(0.097)	(0.010)	(0.010)	(0.016)	(0.005)	(0.206)	(0.022)	(0.024)	(0.037)
Obs	91,047	91,047	91,047	91,047	91,047	85,083	85,083	85,083	85,083	85,083
# Banks	3,397	3,397	3,397	3,397	3,397	3,281	3,281	3,281	3,281	3,281
R^2-adj.	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05
AR(1)	0.26	0.30	0.23	0.25	0.25	0.08	0.08	0.08	0.08	0.08
AR(2)	0.03	0.04	0.02	0.02	0.02	0.25	0.26	0.26	0.26	0.26

Notes: ΔIP, ΔPrice, and ΔIR denote real industry-specific output growth, industry inflation, and the change in the money market interest rate, respectively. 'Char' stands for the bank characteristic, which is either bank asset size (Size), capitalization (Cap), broad liquidity (Bliq), narrow liquidity (Nliq), or short-term interbank claims (Ibk). The dynamic panel model is estimated with the fixed effects estimator. The parentheses contain White-period standard errors (Arellano, 1987). *, **, *** denote the statistical significance at the one, five, and ten percent level, respectively. AR(1) and AR(2) are the p-values associated with tests of first- and second-order serial correlation of the residuals (cf. section 4.2).

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	Energy					Construction				
Bank Characteristic:	Size	Cap	Bliq	Nliq	Ibk	Size	Cap	Bliq	Nliq	Ibk
Long-Run Coefficients										
ΔIP	1.173	0.980	1.348	1.293	1.350	0.716 *	0.651 *	0.649 *	0.678 *	0.645 *
	(1.422)	(1.421)	(1.422)	(1.422)	(1.423)	(0.100)	(0.100)	(0.099)	(0.099)	(0.101)
ΔPrice	4.712 *	4.340 **	4.857 *	4.754 *	4.855 *	5.248 *	4.457 *	4.889 *	5.156 *	5.393 *
	(1.720)	(1.720)	(1.721)	(1.718)	(1.718)	(0.273)	(0.297)	(0.266)	(0.258)	(0.281)
ΔIR	-0.074 *	-0.045 *	-0.053 *	-0.057 *	-0.056 *	0.007 *	0.009 *	0.010 *	0.009 *	0.010 *
	(0.015)	(0.014)	(0.013)	(0.013)	(0.013)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Char*ΔIR	0.024 *	-1.903	0.216	0.126	0.364	-0.001	0.164	0.045 ***	0.022	0.103 ***
	(0.008)	(1.143)	(0.135)	(0.137)	(0.280)	(0.002)	(0.237)	(0.026)	(0.027)	(0.056)
Short-Run Coefficient										
$Char_{t-1}$	0.069 **	-6.473 *	0.290 **	0.242	0.196	-0.010 **	-1.089 *	0.149 *	0.143 *	0.058
	(0.031)	(1.323)	(0.146)	(0.153)	(0.214)	(0.005)	(0.225)	(0.021)	(0.022)	(0.035)
Obs	28,012	28,012	28,012	28,012	28,012	87,533	87,533	87,533	87,533	87,533
# Banks	1,900	1,900	1,900	1,900	1,900	3,342	3,342	3,342	3,342	3,342
R^2-adj.	0.11	0.11	0.11	0.11	0.11	0.04	0.04	0.04	0.04	0.04
AR(1)	0.88	0.88	0.88	0.89	0.88	0.25	0.28	0.26	0.26	0.27
AR(2)	0.08	0.08	0.09	0.09	0.08	0.06	0.07	0.06	0.06	0.07

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	Wholesale and Retail Trade					Transport and Communication				
Bank Characteristic:	Size	Cap	Bliq	Nliq	Ibk	Size	Cap	Bliq	Nliq	Ibk
Long-Run Coefficients										
ΔIP	1.724 *	1.616 *	1.607 *	1.695 *	1.669 *	0.169	0.176	0.193	0.169	0.143
	(0.269)	(0.270)	(0.270)	(0.269)	(0.271)	(0.323)	(0.324)	(0.325)	(0.324)	(0.326)
ΔPrice	1.436 *	1.289 *	1.371 *	1.439 *	1.464 *	-0.392 ***	-0.537 **	-0.398 ***	-0.388 ***	-0.449 **
	(0.083)	(0.086)	(0.083)	(0.082)	(0.083)	(0.228)	(0.233)	(0.229)	(0.227)	(0.227)
ΔIR	0.009 *	0.012 *	0.012 *	0.009 *	0.009 *	-0.008 **	-0.004	-0.006 ***	-0.008 **	-0.010 *
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)
Char*ΔIR	0.006 *	0.140	0.043 **	0.018	0.090 **	0.003	0.333	0.033	0.084 **	-0.207 **
	(0.001)	(0.179)	(0.021)	(0.022)	(0.046)	(0.002)	(0.376)	(0.041)	(0.042)	(0.086)
Short-Run Coefficient										
$Char_{t-1}$	0.008 ***	-0.955 *	0.136 *	0.140 *	0.037	0.004	-0.996 *	0.074 **	0.081 **	-0.086
	(0.004)	(0.178)	(0.018)	(0.019)	(0.031)	(0.008)	(0.359)	(0.035)	(0.038)	(0.062)
Obs	87,408	87,408	87,408	87,408	87,408	75,907	75,907	75,907	75,907	75,907
# Banks	3,356	3,356	3,356	3,356	3,356	3,151	3,151	3,151	3,151	3,151
R^2-adj.	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
AR(1)	0.10	0.10	0.10	0.10	0.10	0.08	0.08	0.08	0.08	0.08
AR(2)	0.05	0.06	0.05	0.05	0.05	0.03	0.03	0.03	0.03	0.03

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	Finance and Insurance					Service				
Bank Characteristic:	Size	Cap	Bliq	Nliq	Ibk	Size	Cap	Bliq	Nliq	Ibk
Long-Run Coefficients										
ΔIP	-5.550 *	-5.145 *	-4.950 *	-4.610 *	-4.811 *	1.456 **	1.480 **	1.649 *	1.206 **	1.473 **
	(0.529)	(0.508)	(0.496)	(0.490)	(0.502)	(0.611)	(0.613)	(0.613)	(0.609)	(0.626)
ΔPrice	0.178	-0.316	0.251	0.502	0.060	1.882 *	1.627 *	1.893 *	1.980 *	1.921 *
	(0.617)	(0.634)	(0.620)	(0.617)	(0.642)	(0.221)	(0.225)	(0.220)	(0.221)	(0.222)
ΔIR	0.032 *	0.031 *	0.029 *	0.027 **	0.019	-0.003	0.002	-0.001	-0.004 ***	-0.005 ***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Char*ΔIR	-0.010 **	1.514 *	0.044	0.111	-0.222	0.004 *	0.386 ***	0.004	0.018	-0.041
	(0.004)	(0.584)	(0.074)	(0.075)	(0.166)	(0.001)	(0.208)	(0.025)	(0.025)	(0.052)
Short-Run Coefficient										
$Char_{t-1}$	0.108 *	-4.485 *	0.388 *	0.270 *	0.206 ***	0.023 *	-1.411 *	0.153 *	0.141 *	0.031
	(0.016)	(0.673)	(0.067)	(0.068)	(0.115)	(0.005)	(0.183)	(0.019)	(0.020)	(0.032)
Obs	54,406	54,406	54,406	54,406	54,406	88,320	88,320	88,320	88,320	88,320
# Banks	2,812	2,812	2,812	2,812	2,812	3,389	3,389	3,389	3,389	3,389
R^2-adj.	0.06	0.06	0.06	0.06	0.06	0.02	0.02	0.02	0.02	0.02
AR(1)	0.87	0.87	0.86	0.88	0.87	0.08	0.08	0.08	0.08	0.07
AR(2)	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.05	0.04	0.04

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	Grand Total of Manufacturing					Chemicals & Coke				
Bank Characteristic:	Size	Cap	Bliq	Nliq	Ibk	Size	Cap	Bliq	Nliq	Ibk
Long-Run Coefficients										
ΔIP	-0.588 *	-0.561 *	-0.657 *	-0.647 *	-0.641 *	0.478	0.847	0.772	0.773	0.771
	(0.139)	(0.142)	(0.140)	(0.141)	(0.143)	(0.845)	(0.853)	(0.852)	(0.849)	(0.880)
ΔPrice	2.969 *	2.653 *	2.928 *	3.019 *	2.810 *	4.129 *	4.312 *	4.425 *	4.368 *	4.340 *
	(0.589)	(0.601)	(0.592)	(0.588)	(0.602)	(1.343)	(1.360)	(1.355)	(1.349)	(1.410)
ΔIR	-0.009 *	-0.005 ***	-0.005 ***	-0.008 *	-0.006 **	-0.031 **	-0.014	-0.023 ***	-0.024 **	-0.019
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)
Char*ΔIR	0.006 *	0.515 *	-0.010	0.007	-0.035	0.016 **	-1.212	0.104	0.105	0.104
	(0.001)	(0.192)	(0.021)	(0.021)	(0.045)	(0.007)	(1.082)	(0.128)	(0.124)	(0.270)
Short-Run Coefficient										
$Char_{t-1}$	-0.002	-0.278	0.086 *	0.062 *	0.052	0.090 *	-3.743 *	0.075	-0.124	0.374 ***
	(0.004)	(0.189)	(0.020)	(0.021)	(0.032)	(0.033)	(1.453)	(0.142)	(0.146)	(0.208)
Obs	89,297	89,297	89,297	89,297	89,297	23,518	23,518	23,518	23,518	23,518
# Banks	3,370	3,370	3,370	3,370	3,370	1,540	1,540	1,540	1,540	1,540
R^2-adj.	0.05	0.05	0.05	0.05	0.05	0.10	0.10	0.10	0.10	0.10
AR(1)	0.15	0.15	0.15	0.15	0.15	0.73	0.74	0.74	0.75	0.73
AR(2)	0.10	0.10	0.09	0.09	0.10	0.24	0.24	0.23	0.24	0.23

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	Rubber & Plastic					Non-Metallic Mineral				
Bank Characteristic:	Size	Cap	Bliq	Nliq	Ibk	Size	Cap	Bliq	Nliq	Ibk
Long-Run Coefficients										
ΔIP	-1.258 *	-1.158 **	-1.305 *	-1.169 **	-1.212 **	-1.528 *	-1.647 *	-1.449 *	-1.445 *	-1.465 *
	(0.458)	(0.467)	(0.466)	(0.465)	(0.475)	(0.403)	(0.402)	(0.406)	(0.399)	(0.407)
ΔPrice	8.117 *	7.747 *	7.694 *	7.627 *	7.670 *	3.174	2.264	2.388	2.285	1.721
	(2.464)	(2.425)	(2.417)	(2.406)	(2.440)	(3.182)	(3.182)	(3.185)	(3.152)	(3.245)
ΔIR	-0.009	0.006	0.000	-0.003	0.002	0.020 *	0.032 *	0.017 *	0.017 *	0.015 **
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Char*ΔIR	0.012 **	-0.015	0.016	0.054	-0.035	-0.001	0.705	0.026	0.019	0.008
	(0.005)	(0.729)	(0.090)	(0.088)	(0.207)	(0.004)	(0.647)	(0.071)	(0.070)	(0.159)
Short-Run Coefficient										
$Char_{t-1}$	0.024	-1.960 **	0.102	-0.053	0.301 ***	0.035 **	-3.170 *	0.055	0.072	-0.044
	(0.020)	(0.880)	(0.089)	(0.092)	(0.161)	(0.015)	(0.684)	(0.072)	(0.074)	(0.122)
Obs	37,966	37,966	37,966	37,966	37,966	51,903	51,903	51,903	51,903	51,903
# Banks	2,073	2,073	2,073	2,073	2,073	2,563	2,563	2,563	2,563	2,563
R^2-adj.	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
AR(1)	0.44	0.44	0.44	0.44	0.43	0.25	0.23	0.24	0.24	0.24
AR(2)	0.52	0.53	0.53	0.53	0.51	0.13	0.12	0.12	0.13	0.13

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	Textiles					Food				
Bank Characteristic:	Size	Cap	Bliq	Nliq	Ibk	Size	Cap	Bliq	Nliq	Ibk
Long-Run Coefficients										
ΔIP	0.756	0.405	0.617	0.770	0.647	3.099 *	3.110 *	2.909 *	2.955 *	2.911 *
	(0.491)	(0.493)	(0.488)	(0.484)	(0.490)	(0.546)	(0.551)	(0.544)	(0.540)	(0.553)
ΔPrice	5.761 ***	5.641 ***	6.086 **	5.750 ***	5.708 ***	3.824 *	3.871 *	3.770 *	3.753 *	3.630 *
	(3.091)	(3.063)	(3.047)	(3.040)	(3.076)	(0.781)	(0.800)	(0.791)	(0.781)	(0.806)
ΔIR	-0.018 **	-0.001	-0.009	-0.014 ***	-0.012	0.002	0.004	0.007 ***	0.005	0.004
	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Char*ΔIR	0.010 *	0.533	0.046	0.106 ***	-0.180	0.006 **	0.483	0.072 ***	0.065	0.035
	(0.003)	(0.512)	(0.057)	(0.057)	(0.123)	(0.003)	(0.376)	(0.042)	(0.043)	(0.094)
Short-Run Coefficient										
$Char_{t-1}$	0.008	-1.846 *	0.183 *	0.096 ***	0.110	-0.006	0.130	0.129 *	0.129 *	0.028
	(0.012)	(0.519)	(0.055)	(0.057)	(0.092)	(0.009)	(0.378)	(0.038)	(0.039)	(0.068)
Obs	60,518	60,518	60,518	60,518	60,518	77,693	77,693	77,693	77,693	77,693
# Banks	2,887	2,887	2,887	2,887	2,887	3,233	3,233	3,233	3,233	3,233
R^2-adj.	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
AR(1)	0.67	0.66	0.66	0.66	0.66	0.09	0.09	0.09	0.09	0.09
AR(2)	0.23	0.23	0.23	0.22	0.22	0.01	0.01	0.01	0.01	0.01

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